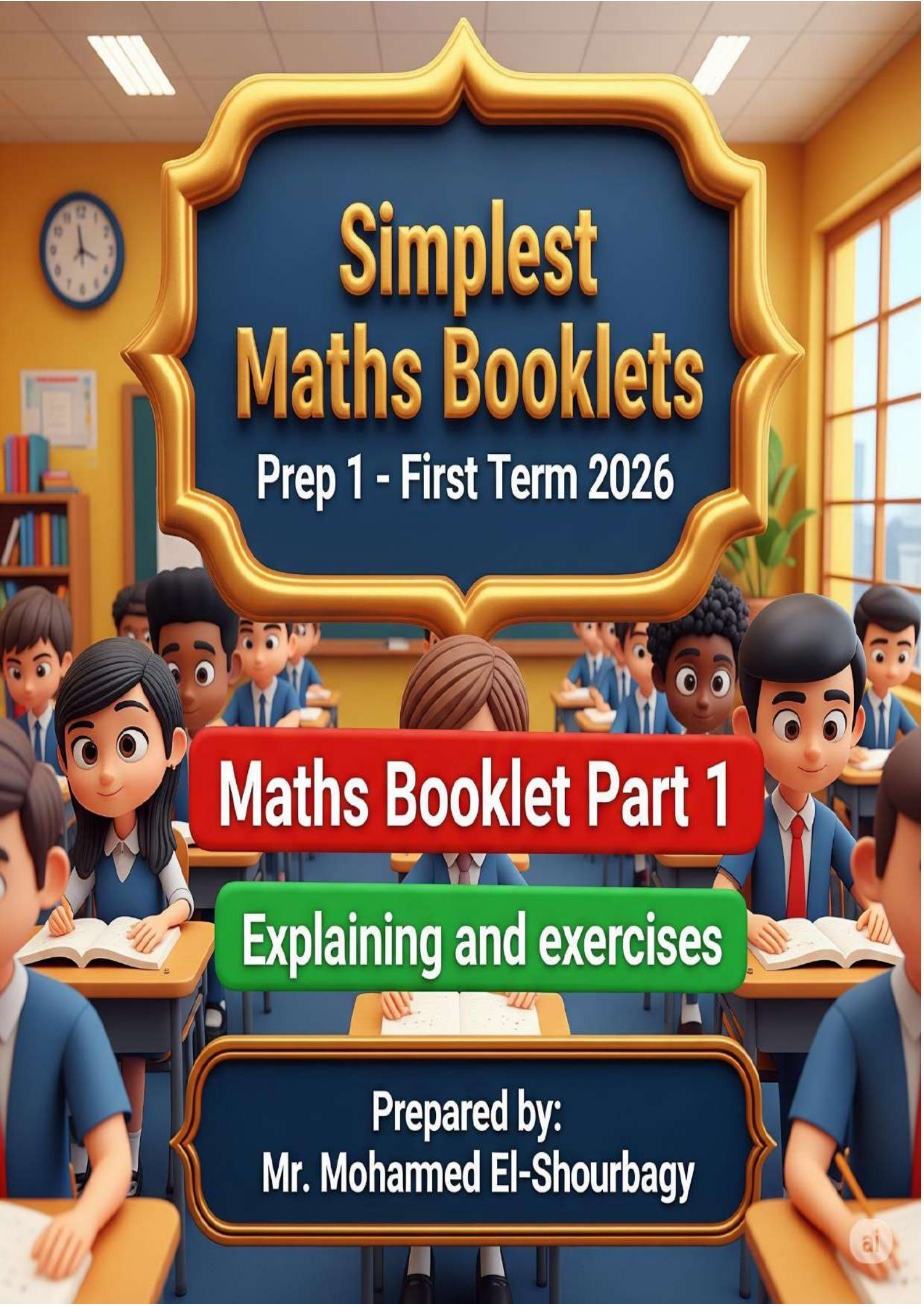


The background of the entire image is a vibrant, cartoon-style illustration of a classroom. Several diverse students in blue school uniforms are seated at their desks, some looking towards the camera and others at their books. A clock is visible on the left wall, and a window is on the right. The overall atmosphere is bright and educational.

Simplest Maths Booklets

Prep 1 - First Term 2026

Maths Booklet Part 1

Explaining and exercises

Prepared by:
Mr. Mohamed El-Shourbagy

SIMPLEST MATHS BOOKLETS

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SIMPLEST MATHS BOOKLETS

Lesson 1: Proportion

Unit 1

Concept of Proportion

A proportion is an equality of at least two ratios or two rates.

Example : $\frac{4}{8} = \frac{1}{2}$ (Equality of two ratios) , $\frac{8 \text{ eggs}}{2 \text{ cups of flour}} = \frac{4 \text{ eggs}}{1 \text{ cup of flour}}$ (Equality of two rates)

Writing Proportion

- If the quantities a , b , c and d are proportional quantities , then : $\frac{a}{b} = \frac{c}{d}$

For example : 3 , 4 , 6 and 8 are proportional quantities , then : $\frac{3}{4} = \frac{6}{8}$

- And vice versa , if $\frac{a}{b} = \frac{c}{d}$ then : a , b , c and d are proportional quantities

For example : If $\frac{3}{4} = \frac{6}{8}$, then : 3 , 4 , 6 and 8 are proportional quantities

If $\frac{a}{b} = \frac{c}{d}$
then :
Means
 $a : b = c : d$
Extremes

Property of Cross Multiplication

If two ratios are equal , you will find that : Product of **Extremes** = Product of **Means**

- If $\frac{a}{b} = \frac{c}{d}$ then : $a \times d = b \times c$

For example : $\frac{3}{4} = \frac{6}{8}$ then : $3 \times 8 = 4 \times 6$
 $24 = 24$

- And vice versa , if $a \times d = b \times c$ then : a , b , c and d are proportional quantities

Example ①

Determine which of the following pairs of ratios represents a proportion :

- ① $\frac{3}{8}$, $\frac{6}{10}$ ② $\frac{8}{10}$, $\frac{12}{15}$



Solution

- If the product of the extremes equals the product of the means , then this pair of ratios represent a proportion.
- If the two ratios are equivalent , then this pair of ratios represent a proportion.

① $\frac{3}{8}$, $\frac{6}{10}$

$3 \times 10 = 30$ $6 \times 8 = 48$ Product of extremes $\neq$ product of means

therefore : $\frac{3}{8} \neq \frac{6}{10}$
i.e. $\frac{3}{8}$ and $\frac{6}{10}$ don't represent a proportion

Another solution :

$\frac{6 \div 2}{10 \div 2} = \frac{3}{5}$ (simplified)

$\frac{3}{8} \neq \frac{3}{5}$

i.e. $\frac{3}{8}$ and $\frac{6}{10}$ don't represent a proportion.

② $\frac{8}{10}$, $\frac{12}{15}$

$8 \times 15 = 120$ $12 \times 10 = 120$ Product of extremes $=$ product of means

therefore : $\frac{8}{10} = \frac{12}{15}$
i.e. $\frac{8}{10}$ and $\frac{12}{15}$ represent a proportion

Another solution :

$\frac{12 \div 3}{15 \div 3} = \frac{4}{5}$, $\frac{8 \div 2}{10 \div 2} = \frac{4}{5}$

$\frac{12}{15} = \frac{8}{10}$

i.e. $\frac{8}{10}$ and $\frac{12}{15}$ represent a proportion.

SIMPLEST MATHS BOOKLETS

Solving Proportion

Solving the proportion means finding the unknown value in the proportion.

Example 2

Solve each of the following proportions :

$$\textcircled{1} \frac{4}{12} = \frac{20}{x}$$

$$\textcircled{2} \frac{4}{7} = \frac{x}{35}$$

$$\textcircled{3} \frac{3}{x-3} = \frac{12}{8}$$

$$\textcircled{4} \frac{40}{2x} = \frac{5}{7}$$

Solution

① Using cross multiplication :

$$4 \times x = 20 \times 12$$

Multiply : $4x = 240$

Divide by 4 : $\frac{4x}{4} = \frac{240}{4}$

Simplify : $x = 60$

Short answer

$$\frac{4}{12} = \frac{20}{x} \Rightarrow x = \frac{20 \times 12}{4} = 60$$

② Using cross multiplication :

$$4 \times 35 = 7 \times x$$

$$140 = 7x$$

$$\frac{140}{7} = \frac{7x}{7}$$

$$x = 20$$

Short answer

$$\frac{4}{7} = \frac{x}{35} \Rightarrow x = \frac{4 \times 35}{7} = 20$$

$$\textcircled{3} \frac{3}{x-3} = \frac{12}{8} \Rightarrow x-3 = \frac{3 \times 8}{12} = 2$$

$$x = 2 + 3 = 5$$

$$\textcircled{4} \frac{40}{2x} = \frac{5}{7} \Rightarrow 2x = \frac{7 \times 40}{5} = 56$$

$$x = \frac{56}{2} = 28$$

Life Applications on Proportion

Example 3

A car consumes 3 liters of gasoline to travel 33 km.

How many liters of gasoline does it need to travel 121 km.

if it consumes gasoline at the same rate?



Solution

Assume the car consumes x liters of gasoline to travel 121 km.

$$\frac{x}{121} = \frac{3}{33}$$

$$33 \times x = 3 \times 121$$

$$33x = 363$$

$$\frac{33x}{33} = \frac{363}{33}$$

$$x = 11$$

Short answer

$$x = \frac{3 \times 121}{33} = 11$$

which means that the car needs 11 liters of gasoline.

SIMPLEST MATHS BOOKLETS

Graphical Representation of Proportion

When plotting points on a graph :

- If the plotted points lie on a straight line passing through the origin , then the relationship represents a proportion.
- If the plotted points do not lie on a straight line , or they lie on a straight line that does not pass through the origin , then the relationship does not represent a proportion.

Example 4

The two tables below show the distance in kilometers covered by a car. Determine graphically the relation between the distance and time , then determine whether the distance in kilometers is proportional to the time in hours.

①

Covered Distances

Time (hours)	Distance (km)
1	70
2	140
3	210
4	280

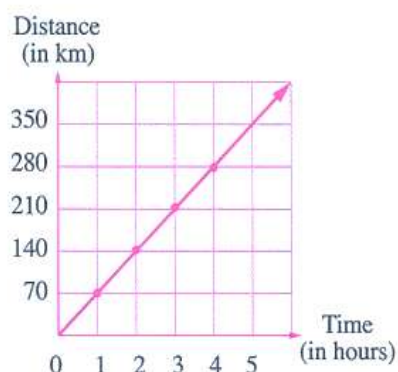
②

Covered Distances

Time (hours)	Distance (km)
1	80
2	100
3	190
4	260

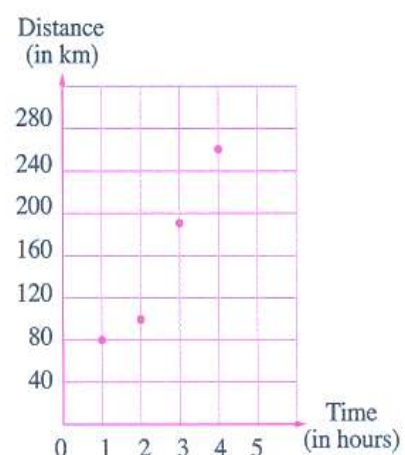
Solution

①



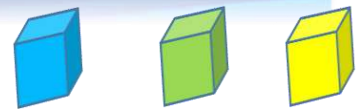
The distance in kilometers is proportional to the time in hours

②

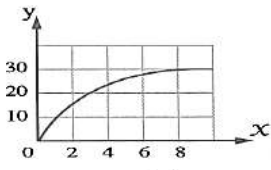
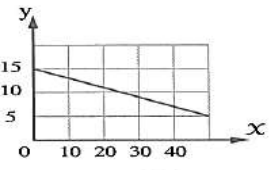
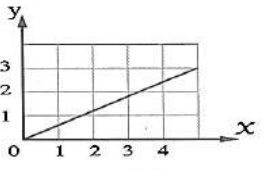
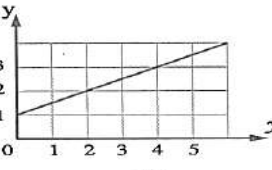


The distance in kilometers is not proportional to the time in hours.

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Ex.1) Choose the correct answer :

- 1  $\frac{20}{25} = \frac{36}{\dots\dots}$ a) 3 b) 45 c) 30 d) 40
- 2  $\frac{48}{72} = \frac{\dots\dots}{15}$ a) 5 b) 30 c) 10 d) 34
- 3  $\frac{6}{8} = \frac{\dots\dots}{\dots\dots}$ a) $\frac{1}{5}$ b) $\frac{3}{4}$ c) $\frac{3}{7}$ d) $\frac{5}{8}$
- 4  $\frac{12}{\dots\dots} = \frac{\dots\dots}{15}$ a) 10,18 b) 3,6 c) 4,5 d) 1,7
- 5 If $\frac{8}{x} = 0.5$ what is the value of x ?
(a) 4 (b) 8 (c) 16 (d) 40
- 6 If $\frac{18}{24} = \frac{3}{a-1}$ what is the value of a ?
(a) 6 (b) 4 (c) 5 (d) 3
- 7  Which of the following represents a proportion ?
(a) The price of 3 kg of bananas is 54 LE , and the price of 5 kg of bananas is 80 LE
(b) 10 goals out of 12 attempts , and 12 goals out of 18 attempts.
(c) Reading 3 books in 2 months , and reading 9 books in 6 months.
(d) 144 pulses in 2 minutes , and 210 pulses in 3 minutes.
- 8  Magdy can run 75 meters in 25 seconds. If he maintained his speed , which proportion you can use to find the time (x) he needs to run 300 meters ?
(a) $\frac{75}{25} = \frac{x}{300}$ (b) $\frac{75}{25} = \frac{300}{x}$ (c) $\frac{25}{x} = \frac{300}{75}$ (d) $\frac{75}{x} = \frac{300}{25}$
- 9  Which of the following graphs represents a proportion ?
 (a)  (b)  (c)  (d)

SIMPLEST MATHS BOOKLETS

10

Which of the following ratios is equal to $\frac{16}{64}$?

(a) $\frac{1}{4}$

(b) $\frac{4}{8}$

(c) $\frac{14}{48}$

(d) $\frac{64}{16}$

11

If $\frac{35}{21} = \frac{x}{3}$, then what is the value of x ?

(a) 3

(b) 5

(c) 7

(d) 9

12

Walid travels 320 km in 2.5 hours. How much time is needed to travel 64 km if he maintains the same speed ?

(a) 5 hours

(b) $\frac{1}{2}$ hour

(c) $\frac{1}{4}$ hour

(d) 2 hours

13

If $\frac{2}{5} = \frac{x}{15}$, then what is the value of $4 + x$?

(a) 6

(b) 8

(c) 10

(d) 12

14

 If 15 % of x equals 20 % of y , then which of the following is equal to $x : y$?

(a) 5 : 4

(b) 3 : 2

(c) 4 : 3

(d) 3 : 4

SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

1

Which of the following represents a proportion :

1 $\frac{2}{5} \stackrel{?}{=} \frac{4}{10}$

2 $\frac{3}{4} \stackrel{?}{=} \frac{6}{9}$

3 $\frac{15}{25} \stackrel{?}{=} \frac{30}{60}$

4 $\frac{1}{3} \stackrel{?}{=} \frac{0.5}{1.5}$

5 $\frac{5}{4} \stackrel{?}{=} \frac{7.5}{6}$

6 $\frac{10}{3} \stackrel{?}{=} \frac{40}{12}$

2

For each of the following, determine whether the quantities are proportional. If they are, write the proportion.

1 5 , 8 , 15 , 24

2 7 , 8 , 14 , 15

3 12 , 27 , 16 , 18

4 8 , 24 , 6 , 18

3

Solve the following proportions :

1 $\frac{3}{4} = \frac{x}{20}$

2 $\frac{6}{x} = \frac{12}{14}$

3 $\frac{15}{x} = \frac{30}{12}$

4 $a : 16 = 5 : 4$

5 $7 : 8 = 21 : m$

6 $\frac{1}{3} = \frac{2}{b+1}$

7 $\frac{l-3}{12} = \frac{5}{4}$

8 $\frac{16}{3x} = \frac{8}{12}$

9 $\frac{8}{y} = \frac{y}{2}$

(where y is a positive integer).

4

Saving : The following table shows how much Ibrahim saves within a certain number of months. Are the amounts saved proportional to the number of months ?

Amount (LE)	300	600	900	1,200
Number of Months	2	4	6	8

5

Shopping : Omar bought 8 apples for 60 LE
How many apples of the same type can he buy for 105 LE ?

6

Science : A car uses 5 liters of petrol to cover a distance of 40 km.
How much petrol would the car need to cover the distance of 128 km if it travels at the same rate ?

7

Culture : Eman reads 10 pages in 40 minutes.
How much time , in hours would it take her to read a book of 120 pages if she reads at the same rate ?

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8

Represent the following tables graphically , then determine which one shows a proportional relationship between the two variables :

1 

Covered Distances	
Time (seconds)	Distance (meters)
1	6
2	12
3	18
4	24

2 

Price of pies including delivery fees	
Number of Pies	Price (LE)
1	25
2	45
3	65
4	85

3

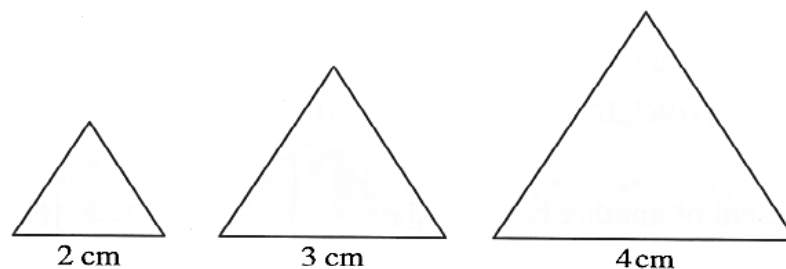
Price of apples in a market	
Weight (kilograms)	Price (LE)
1	45
2	90
3	135
4	180

4

Price of shampoo	
Volume (milliliters)	Price (LE)
100	40
200	50
300	58
400	70

9

 Geometry :



The triangles above are equilateral. Does the relationship between the perimeter and the side length in the equilateral triangles represent a proportion ?

Explain your answer.

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Quiz

Choose the correct answer from the given ones :

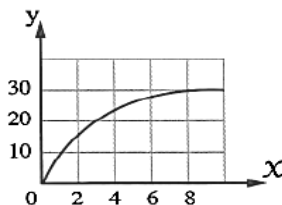
1 Which of the following represents a proportion ?

- (a) The price of 3 kg of bananas is 54 LE , and the price of 5 kg of bananas is 80 LE
- (b) 10 goals out of 12 attempts , and 12 goals out of 18 attempts.
- (c) Reading 3 books in 2 months , and reading 9 books in 6 months.
- (d) 144 pulses in 2 minutes , and 210 pulses in 3 minutes.

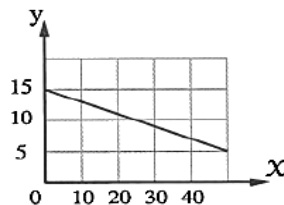
2 Magdy can run 75 meters in 25 seconds. If he maintained his speed , which proportion you can use to find the time (x) he needs to run 300 meters ?

- (a) $\frac{75}{25} = \frac{x}{300}$
- (b) $\frac{75}{25} = \frac{300}{x}$
- (c) $\frac{25}{x} = \frac{300}{75}$
- (d) $\frac{75}{x} = \frac{300}{25}$

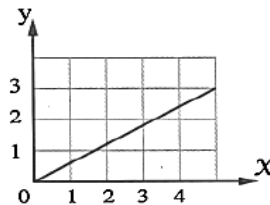
3 Which of the following graphs represents a proportion ?



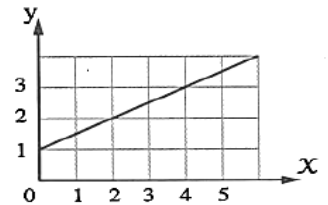
(a)



(b)



(c)



(d)

4 Team X loses against team Y in basketball with a ratio of 3 : 4. Which of the following could be the score of the game ?

- (a) 10 goals for team X and 12 goals for team Y
- (b) 4 goals for team X and 16 goals for team Y
- (c) 16 goals for team X and 12 goals for team Y
- (d) 30 goals for team X and 40 goals for team Y

5 Which of the following ratios is equal to $\frac{16}{64}$?

- (a) $\frac{1}{4}$
- (b) $\frac{4}{8}$
- (c) $\frac{14}{48}$
- (d) $\frac{64}{16}$

6 If $\frac{35}{21} = \frac{x}{3}$, then what is the value of x ?

- (a) 3
- (b) 5
- (c) 7
- (d) 9

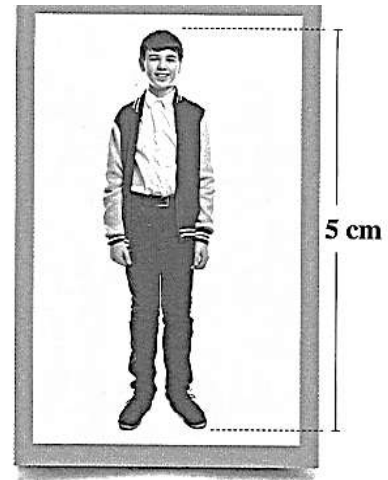
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Lesson 2: Scale drawing

Ahmed took a picture of his brother , and his brother's height in the picture was 5 cm , knowing that his brother's real height is 120 cm.

And this means

5 cm in the picture $\xrightarrow{\text{represents}}$ 120 cm in reality



To clarify this concept , the ratio between his brother's height in the drawing and his real height can be represented as :

$$\begin{array}{rcl} \text{length in the drawing} & : & \text{Real length} \\ \hline 5 & : & 120 \\ \hline 1 & : & 24 \end{array}$$

This means that every 1 cm in the picture represents 24 cm in reality.

Concept of Scale Drawings

Scale Drawings : It is a ratio of the dimension in the drawing or model to the dimension in reality.

$$\text{Scale of Drawing} = \frac{\text{The length in the drawing}}{\text{The real length}}$$

How to Find the Scale Drawings

Example ①

- 1 If the distance between two cities is 80 km and the distance between them on a map is 4 cm , find the scale drawing for this map.
- 2 An enlarged picture of an insect , its real length is 0.5 mm and its length in the picture is 7.5 cm , find the scale drawing.

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Solution

$$\begin{aligned} 1 \text{ The scale drawing} &= \frac{\text{The length in the drawing}}{\text{The real length}} \\ &= \frac{4 \text{ cm}}{80 \text{ km}} = \frac{4}{8,000,000} \\ &= \frac{1}{2,000,000} \end{aligned}$$

The scale drawing can be written as 1 : 2,000,000

2

The length in the drawing	:	The real length
7.5 cm (7.5 cm = 7.5 × 10 mm = 75 mm)	:	0.5 mm
75 mm	:	0.5 mm (× 10)
750	:	5 (÷ 5)
150	:	1

Notice that : In Example 2 , the scale drawing 150 : 1 , means that every 15 cm in the drawing represent 1 mm in reality.

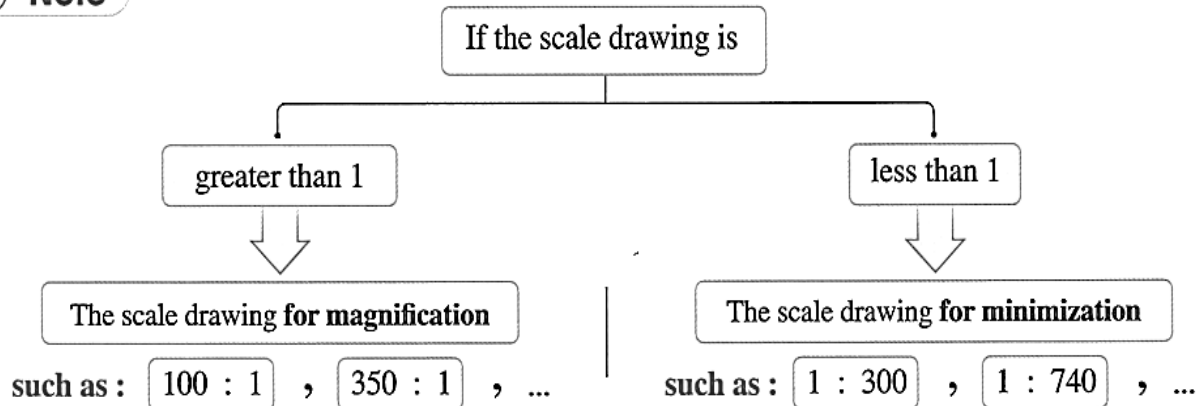
Note

In Example 1 , the scale drawing 1 : 2,000,000 , means every 1 cm in the drawing represents 20 km in reality.

Remember

1 Kilometer = 1,000 Meters
1 Meter = 100 cm
So 1 kilometer = 100,000 cm

Note



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How to Find the Real Length or the Drawing Length

Example ②

If the scale drawing on a map is 1 : 500,000 and the distance between two cities on the map is 3 cm , find the real distance between the two cities.

Solution

The scale drawing = $\frac{\text{The distance on the map}}{\text{The real distance}}$

$$\frac{1}{500,000} = \frac{3 \text{ cm}}{\text{The real distance}}$$

$$\begin{aligned} \text{The real distance} &= \frac{3 \text{ cm} \times 500,000}{1} = 1,500,000 \text{ cm} \quad (\div 100,000) \\ &= 15 \text{ km} \end{aligned}$$

Example ③

If the distance between two cities is 24 km , then find the distance in cm between the two cities on a map given that the scale drawing of the map is 1 : 400,000

Solution

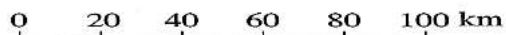
The scale drawing = $\frac{\text{The distance on the map}}{\text{The real distance}}$

$$\frac{1}{400,000} = \frac{\text{The distance on the map}}{(24 \times 100,000) \text{ cm}}$$

$$\text{The distance on the map} = \frac{(24 \times 100,000) \text{ cm} \times 1}{400,000} = 6 \text{ cm}$$

Note

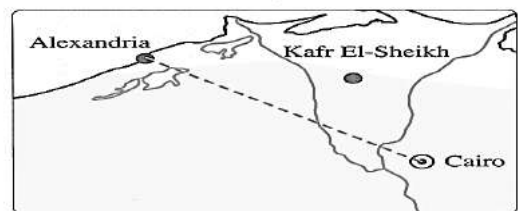
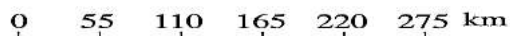
The scale drawings on maps can be expressed as follows :



This means that every 1 cm on the map represents 20 km in reality.

Example ④

Use the ruler to measure the distance between Cairo and Alexandria on the opposite map , and use the map scale to find the actual distance between Cairo and Alexandria.



Solution

Use a ruler to find the distance between the two governorates on the map , which is approximately 4 cm , and since every 1 cm on the map represents 55 km in reality.

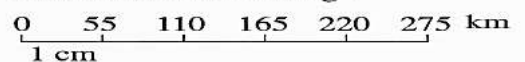
The scale drawing = $\frac{\text{The distance on the map}}{\text{The real distance}}$

$$\frac{1 \text{ cm}}{55 \text{ km}} = \frac{4 \text{ cm}}{\text{The real distance}}$$

$$\text{i.e. The real distance} = \frac{4 \times 55}{1} = 220 \text{ km}$$

Short answer

From the scale drawing :

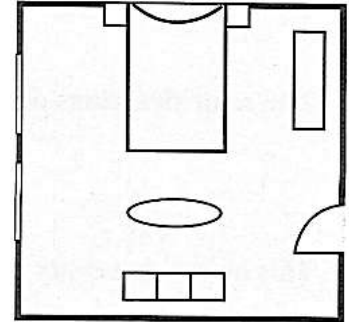


4 cm
The real distance = 220 km

SIMPLEST MATHS BOOKLETS

Example ⑤

The opposite figure represents a model of a square room with a side length of 4 cm , where every 1 cm in the model represents $1\frac{1}{2}$ m in reality Calculate the real area of the room.



Solution

The drawing scale = $\frac{\text{The model length}}{\text{The real length}}$

$$\frac{1 \text{ cm}}{1\frac{1}{2} \text{ m}} = \frac{4 \text{ cm}}{\text{The real side length}}$$

$$\text{The real side length} = \frac{4 \times 1\frac{1}{2}}{1} = 6 \text{ m}$$

Thus , the area of the room = $6 \times 6 = 36 \text{ m}^2$

Short answer

Every 1 cm in the model represents $1\frac{1}{2}$ m in reality ,
then 4 cm in the model represent
 $4 \times 1\frac{1}{2} = 6 \text{ m}$ in reality

Ex.1) Complete the following:

- 1 The scale drawing = $\frac{\dots\dots\dots}{\dots\dots\dots}$
- 2 If the scale drawing > 1 , it represents $\dots\dots\dots$, but if the scale drawing < 1 , it represents $\dots\dots\dots$
- 3 If the scale drawing is $1 : 200$, it represents $\dots\dots\dots$
- 4 If the length in the drawing is 5 cm and the real length is 15 meters , then the scale drawing = $\dots\dots\dots$
- 5 If the length of an insect in the picture is 4 cm and its real length is 2 mm , then the scale drawing = $\dots\dots\dots$

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Ex.2) Answer the following :

1  **Geography** : If the real distance between Cairo and Damietta is 200 km and the distance between them on the map is 5 cm , find the map's scale drawing.

2  **Public Domain** : A model of the Cairo Tower was created at a scale drawing of 1 : 200.
Given that the height of the Cairo Tower is 187 meters , what is the length of the model tower in centimeters ?



3 A magnifying lens is used to magnify an insect. If the real length of the insect is 0.4 mm , and its length after magnification is 4.8 cm. Find the magnification ratio.

4 Mustafa drew a picture of his brother Ahmed.
If the scale drawings is 1 : 4 and Ahmed's height is 160 cm , what is Ahmed's height in the picture ?

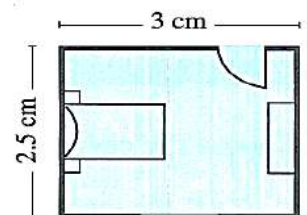


5 A picture of a tree is drawn to scale drawings of 1 : 100. If the real height of the tree is 8 meters , find the height of the tree in the picture.

6 If the distance between two cities on a map is 14 cm , find the real distance between the two cities in kilometers if the scale drawing 1 : 300,000

7  **Maps** : If the scale drawing of a map is 1 : 4,000,000 and the real distance between two cities is 350 km , find the distance between the two cities on the map.

8  **Geometry** : The opposite figure represents a room model , where every 1 cm in the model represents 1.2 m in reality.
What is the room's real area ?



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- 9** **Geometry** : If figure (1) represents a minimization of figure (2) at a scale drawing , and width of room B is x cm , find the value of x .

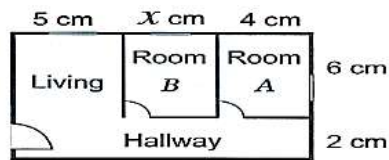


Fig. (1)

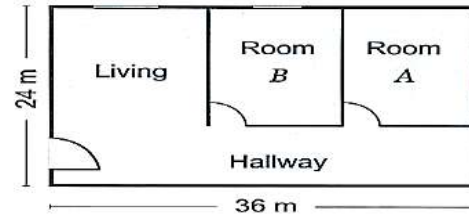
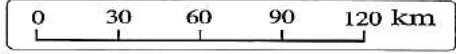


Fig. (2)

Quiz

Choose the correct answer from the given ones :

1. If the length in the drawing is 2 cm and the real length is 6 m , then what is the scale ?
 (a) 1 : 3 (b) 1 : 30
 (c) 1 : 300 (d) 1 : 3,000
2. If the scale drawing is 1 : 1,000 and the length in the drawing is 2.5 cm , then what is the real length in meters ?
 (a) 0.25 meter (b) 25 meters
 (c) 2.5 meters (d) 250 meters
3. If the real length is 90 meters and the scale drawing is 1 : 10,000 , then what is the length in the drawing in centimeters?
 (a) 0.09 cm (b) 90 cm
 (c) 9 cm (d) 0.9 cm
4. If the length of an insect is 0.3 mm and its length after magnification is 4.5 cm , then what is the magnification ratio ?
 (a) 1 : 15 (b) 15 : 1
 (c) 1 : 150 (d) 150 : 1
5. Which of the following scale drawings represents a minimization ?
 (a) 70 : 1 (b) 1 : 7,000
 (c) 500 : 1 (d) 7,000 : 1
6. Which of the following scale drawings represents a magnification ?
 (a) 1 : 20 (b) 1 : 50,000
 (c) 1 : 10 (d) 50 : 1
7. If the length of the Suez Canal draw on a map with scale drawing of 1 : 1,100,000 is 15 cm , then what is its real length in kilometers ?
 (a) 155 (b) 165
 (c) 170 (d) 185
8. If the scale drawing of a map is

 and the distance between two cities on the map is 3 cm , then what is the real distance between them ?
 (a) 30 km (b) 1,200,000 cm
 (c) 90 km (d) 90,000 cm
9. If every 1 cm in the picture represents 3 meters in reality , then what is the real length of the boat ?
 (a) 2.5 cm (b) 7.5 cm
 (c) 2.5 m (d) 7.5 m



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Lesson 3: Proportional division

Concept of Proportional Division

Proportional division is dividing something such as money , a piece of land , or weight , etc. into two or more parts based on a specific ratio.

Proportional division is used in many real-life applications , including dividing profits , distributing inheritance , and other practical applications.



Division of an Amount of Money or a Land in a Given Proportion

Example ①

A man wants to divide 1,200 LE between two persons in the ratio of 2 : 1.
What is the share of each ?

Solution

The sum of all parts = $1 + 2 = 3$

The value of one part = $\frac{1,200}{3}$
= 400 LE

- First person's share = 2×400
= 800 LE
- Second person's share = 1×400
= 400 LE

Another solution : _____

First	:	Second	:	Total
2	:	1	:	3
?	:	?	:	1,200

- First person's share = $\frac{2 \times 1,200}{3} = 800$ LE
- Second person's share = $\frac{1 \times 1,200}{3} = 400$ LE

Example ②

108 LE were divided among three persons in the ratio of 2 : 3 : 4. Find the share of each.

Solution

The sum of all parts = $2 + 3 + 4 = 9$

The value of one part = $\frac{108}{9} = 12$ LE

- First person's share = 12×2
= 24 LE
- Second person's share = 12×3
= 36 LE
- Third person's share = 12×4
= 48 LE

Another solution : _____

First	:	Second	:	Third	:	Total
2	:	3	:	4	:	9
?	:	?	:	?	:	108

- First person's share = $\frac{2 \times 108}{9} = 24$ LE
- Second person's share = $\frac{3 \times 108}{9} = 36$ LE
- Third person's share = $\frac{4 \times 108}{9} = 48$ LE

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Example ③

A piece of land is divided between two brothers in the ratio of 3 : 5. If the elder brother's share exceeds the younger brother's share by 20 square meters, find the share of each and the total area of the land.

Solution

The difference between the parts

$$= 5 - 3 = 2$$

The value of one part

$$= \frac{20}{2} = 10 \text{ square meters}$$

- Younger brother's share
 $= 3 \times 10 = 30 \text{ square meters}$
- Elder brother's share
 $= 5 \times 10 = 50 \text{ square meters}$
- Total area of the land
 $= 30 + 50 = 80 \text{ square meters}$

Another solution : _____

Younger Brother	:	Elder Brother	:	Difference
3	:	5	:	2
?	:	?	:	20

- Younger brother's share $= \frac{3 \times 20}{2} = 30 \text{ square meters}$
- Elder brother's share $= \frac{5 \times 20}{2} = 50 \text{ square meters}$
- Total area of the land $= 30 + 50 = 80 \text{ square meters}$

Division of Profits or Losses Based on Capital

Example ④

Three persons invested in a business in the ratio of 3 : 4 : 5

The first one has a profit share 15,000 LE.

Calculate the share of the profit of each the second and third persons.



Solution

$$\begin{aligned} \text{The value of one part} &= \frac{15,000}{3} \\ &= 5,000 \text{ LE} \end{aligned}$$

- Second person's share $= 4 \times 5,000$
 $= 20,000 \text{ LE}$
- Third person's share $= 5 \times 5,000$
 $= 25,000 \text{ LE}$

Another solution : _____

First	:	Second	:	Third
3	:	4	:	5
15,000	:	?	:	?

- Second person's share $= \frac{15,000 \times 4}{3}$
 $= 20,000 \text{ LE}$
- Third person's share $= \frac{15,000 \times 5}{3}$
 $= 25,000 \text{ LE}$

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Example ⑤

If what Mohamed earns is twice what Bassem earns and the total amount of what they both get is 21,000 LE.
How much does each one of them get ?



Note

- If the first person's share is half of the second's , the ratio between them is $1 : 2 = \frac{1}{2}$
- If the first person's share is twice the second's , the ratio between them is $2 : 1 = \frac{2}{1}$

Solution

The ratio between what Mohamad earns and what Bassem earns = $2 : 1$

The sum of all parts = $2 + 1 = 3$

The value of one part = $\frac{21,000}{3} = 7,000$ LE

- Mohamad's earnings = $2 \times 7,000$
= 14,000 LE
- Bassem's earnings = $1 \times 7,000$
= 7,000 LE

Another solution :

Mohamed	:	Bassem	:	Total
2	:	1	:	3
?	:	?	:	21,000

- Mohamad's earnings = $\frac{2 \times 21,000}{3}$
= 14,000 LE
- Bassem's earnings = $\frac{1 \times 21,000}{3}$
= 7,000 LE

Example ⑥

Three persons invested in a business. The first invested 250,000 LE , the second 200,000 LE , and the third 300,000 LE. By the end of the year , the profit was 150,000 LE.
Calculate the share of each one in the profit.

Solution

First	:	Second	:	Third
250,000	:	200,000	:	300,000 ($\div 10,000$)
25	:	20	:	30 ($\div 5$)
5	:	4	:	6

The sum of the parts = $6 + 4 + 5 = 15$

The value of one part = $\frac{150,000}{15}$
= 10,000 LE.

- First person's share
= $5 \times 10,000 = 50,000$ LE
- Second person's share
= $4 \times 10,000 = 40,000$ LE
- Third person's share
= $6 \times 10,000 = 60,000$ LE

Another solution :

First	:	Second	:	Third	:	Total
250,000	:	200,000	:	300,000	:	750,000
?	:	?	:	?	:	150,000

- First person's share = $\frac{250,000 \times 150,000}{750,000}$
= 50,000 LE
- Second person's share = $\frac{200,000 \times 150,000}{750,000}$
= 40,000 LE
- Third person's share = $\frac{300,000 \times 150,000}{750,000}$
= 60,000 LE

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Division of Inheritance or Partnership

Example 7

A man passed away , leaving an inheritance of 600,000 LE to be distributed among his wife , two sons and a daughter. If the wife's share was $\frac{1}{8}$ of the amount , the daughter share is half the share of the son , find the share of each the daughter , son , and wife.

Solution

$$\begin{aligned}\text{Wife's share} &= \frac{1}{8} \times 600,000 \\ &= 75,000 \text{ LE}\end{aligned}$$

$$\begin{aligned}\text{The remaining} &= \\ 600,000 - 75,000 &= 525,000 \text{ LE}\end{aligned}$$

$$\begin{array}{cccc}\text{Daughter} & : & \text{Son} & : & \text{Son} \\ 1 & : & 2 & : & 2\end{array}$$

$$\text{The sum of all parts} = 2 + 2 + 1 = 5$$

$$\begin{aligned}\text{The value of one part} &= \frac{525,000}{5} \\ &= 105,000 \text{ LE}\end{aligned}$$

- Daughter's share = 105,000 LE
- Son's share = 210,000 LE

Another solution : _____

$$\text{Wife's share} = \frac{1}{8} \times 600,000 = 75,000 \text{ LE}$$

$$\text{The remaining} = 600,000 - 75,000 = 525,000 \text{ LE}$$

$$\begin{array}{cccccc}\text{Daughter} & : & \text{Son} & : & \text{Son} & : & \text{Total} \\ 1 & : & 2 & : & 2 & : & 5 \\ ? & : & ? & : & ? & : & 525,000\end{array}$$

$$\begin{aligned}\bullet \text{ Daughter's share} &= \frac{1 \times 525,000}{5} \\ &= 105,000 \text{ LE}\end{aligned}$$

$$\begin{aligned}\bullet \text{ Son's share} &= \frac{2 \times 525,000}{5} \\ &= 210,000 \text{ LE}\end{aligned}$$

Other Applications on Proportional Division

Example 8

A miner extracted metal alloy containing three metals of silver , tin , and copper in the ratio of $\frac{1}{9} : \frac{1}{6} : \frac{1}{4}$

If the total mass of the alloy is 285 grams , find the mass of each metal in the alloy.

Solution

$$\begin{array}{cccc}\text{Silver} & : & \text{Tin} & : & \text{Copper} \\ \frac{1}{9} & : & \frac{1}{6} & : & \frac{1}{4} \quad (\times 36) \\ \text{(Since the L.C.M of the denominators is 36)} \\ 4 & : & 6 & : & 9\end{array}$$

$$\text{The sum of all parts} = 4 + 6 + 9 = 19$$

$$\text{The value of one part} = \frac{285}{19} = 15 \text{ grams}$$

- Silver mass = $4 \times 15 = 60$ grams
- Tin mass = $6 \times 15 = 90$ grams
- Copper mass = $9 \times 15 = 135$ grams

Another solution : _____

$$\begin{array}{cccccc}\text{Silver} & : & \text{Tin} & : & \text{Copper} & : & \text{Total} \\ 4 & : & 6 & : & 9 & : & 19 \\ ? & : & ? & : & ? & : & 285\end{array}$$

$$\bullet \text{ Silver mass} = \frac{4 \times 285}{19} = 60 \text{ grams}$$

$$\bullet \text{ Tin mass} = \frac{6 \times 285}{19} = 90 \text{ grams}$$

$$\bullet \text{ Copper mass} = \frac{9 \times 285}{19} = 135 \text{ grams}$$

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Ex.1) Answer the following :

- 1 360 LE were distributed between Hani and Ahmed in the ratio of 7 : 5
What is the share of each ?
- 2  The ratio between two numbers is 2 : 5. If the smaller number is 48 , what is the larger number ?
- 3  **Education :** If the number of students in a school is 576 , and the ratio of girls to boys is 5 : 3 , find the increase of the number of girls than boys. 
- 4 A piece of land is divided between two persons in the ratio of 5 : 7. If the share of the second person exceeds the share of the first person by 80 square meters , find the share of each.
- 5 A man wants to divide 8,000 LE among his three sons in the ratio of 1 : 2 : 5
Find the share of each.
- 6  Three persons shared 7,200 LE in the ratio of 3 : 4 : 5.
Calculate the share of each one.
- 7  Omar earns twice as much as Khaled. If the sum of their wages is 36,000 LE , what is the wage for each of them ?
- 8  **Geometry :** If the ratio among the side lengths of triangle with a perimeter of 135 cm. is 7 : 5 : 3 , find the length of its longest side.
- 9  **Inheritance :** A man passed away , leaving 150,000 LE for his wife , two sons , and one daughter. If his wife's share is $\frac{1}{8}$ of the total amount , and the remaining sum is to be distributed among his children , what is the share of each son and the daughter , considering the ratio of a son to a daughter is 2 : 1 ?

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Quiz

Choose the correct answer from the given ones :

- | | |
|--|--|
| <p>1 A piece of land with an area of 36 feddans was divided between two persons in the ratio of 7 : 20. Which in the following represent the share of either persons ?</p> <p>(a) 4 feddans (b) 14 feddans
(c) 18 feddans (d) 28 feddans</p> | <p>2 120 LE were divided between two persons in the ratio of 2 : 3. What is the smaller share ?</p> <p>(a) 72 LE (b) 24 LE
(c) 36 LE (d) 48 LE</p> |
| <p>3 Two friends invested in a business in the ratio of 2:5. If the smaller share in the profit is 18,000 LE , then what is the total profit ?</p> <p>(a) 45,000 LE (b) 63,000 LE
(c) 9,000 LE (d) 24,000 LE</p> | <p>4 Ahmed and Hala joined a business project. Ahmed invested 8,000 LE , and Hala invested 6,000 LE. If Ahmed's profit share is 1,200 LE , then how much did Hala earn ?</p> <p>(a) 300 LE (b) 500 LE
(c) 600 LE (d) 900 LE</p> |
| <p>5 If the ratio between Ahmed's and Mustafa's shares of the profits in a business is 2:3 , and Ahmed's share is 6,000 LE , then what is Mustafa's share?</p> <p>(a) 9,000 LE (b) 4,000 LE
(c) 13,000 LE (d) 5,000 LE</p> | <p>6 A man distributed an amount of money between his two sons in the ratio of 4 : 3. If the difference between the elder brother's share and the younger brother's share is 5,000 LE , then what is the elder brother's share ?</p> <p>(a) 15,000 LE (b) 20,000 LE
(c) 5,000 LE (d) 35,000 LE</p> |
| <p>7 The ratio between the lengths of the sides in a triangle is 3 : 4 : 5. If its perimeter is 36 cm , then what is the length of its longest side ?</p> <p>(a) 9 cm (b) 12 cm
(c) 15 cm (d) 24 cm</p> | <p>8 If $a : b = 3 : 7$ and $a + b = 40$, then what is the value of $b - a$?</p> <p>(a) 16 (b) 28
(c) 12 (d) 14</p> |
| <p>9 If $a : b = 2 : 5$ and $a = 14$, then what is the value of b ?</p> <p>(a) 7 (b) 2
(c) 10 (d) 35</p> | <p>10 If $a : b : c = 3 : 2 : 4$ and $c - b = 20$, then what is the value of a ?</p> <p>(a) 10 (b) 20
(c) 30 (d) 40</p> |

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Lesson 4: Applications of percentage

First Calculating the Discount and the Price After the Discount

When the price of an item decreases at a rate of $d\%$,

So : The discount value = price of the item $\times d\% = \text{price of the item} \times \frac{d}{100}$

And the price of the item after the discount = original price of the item – the discount value.

Example ①

A man bought a television from a commercial market.
The list price of the television is 18,500 LE and there is a discount rate of 12% on the listed price, what is its selling price after the discount ?



Solution

The discount value = $18,500 \times \frac{12}{100} = 2,220$ LE

Television price after the discount = $18,500 - 2,220 = 16,280$ LE

Another solution : _____

The discount value can be found using proportion.

$$\begin{array}{lcl} \text{Part} \rightarrow & \frac{12}{100} = & \frac{\text{The discount value}}{18,500} \leftarrow \text{Part} \\ \text{Total} \rightarrow & & \leftarrow \text{Total} \end{array}$$

The discount value = $\frac{12 \times 18,500}{100} = 2,220$ LE

Television price after the discount = $18,500 - 2,220 = 16,280$ LE

Short answer

Original price	:	Discount rate	:	Price after discount
----------------	---	---------------	---	----------------------

100 %	:	12 %	:	88 %
-------	---	------	---	------

18,500	:		:	?
--------	---	--	---	---

Television price after the discount = $\frac{88 \times 18,500}{100} = 16,280$ LE

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Second Calculating the Original Price Before the Discount

Example ②

Ahmed received a 40 % discount rate on a bicycle from a market. If its price after the discount was 8,400 LE , what was the original price of the bicycle?



Solution

The percentage of the original price = 100 %
so the percentage after the discount
is $100 \% - 40 \% = 60 \%$

$$\begin{array}{ccc} \text{Part} & \rightarrow & 60 \\ \text{Total} & \rightarrow & 100 \end{array} = \frac{8,400}{\text{Original price}} \begin{array}{ccc} & \leftarrow & \text{Part} \\ & \leftarrow & \text{Total} \end{array}$$

The original price of the bicycle

$$= \frac{8,400 \times 100}{60} = 14,000 \text{ LE}$$

Another solution : _____

The percentage of the original price = 100 %

The ratio between the percentage of the purchase price to the original price is

$$100 \% - 40 \% = 60 \%$$

$$8,400 = \frac{60}{100} \times \text{the original price}$$

$$\text{The original price} = 8,400 \div \frac{60}{100}$$

$$= 8,400 \times \frac{100}{60} = 14,000 \text{ LE}$$

Short answer

Original price : Discount rate : Price after discount

100 % : 40 % : 60 %

? : : 8,400

$$\text{The original price} = \frac{8,400 \times 100}{60} = 14,000 \text{ LE}$$

SIMPLEST MATHS BOOKLETS

Third Calculating the Addition (Increase) and the Price After the Addition

When the price of an item increases due to a tax or commission or profit margin by a rate $t\%$

So : The increase value = price of the item $\times t\% = \text{price of the item} \times \frac{t}{100}$

The price of the item after the increase = original price of the item + increase value.

Example ③

In a restaurant , Marwan ordered a lunch , and the price of the meal was 540 LE , with an additional 14 % as a tax rate on the meal price.

What is the value of the tax , and how much does Marwan pay ?



Solution

The tax value = $540 \times \frac{14}{100} = 75.6 \text{ LE}$

The amount Marwan pays = $540 + 75.6 = 615.6 \text{ LE}$

Another solution : —————

The amount paid can be found directly using proportion as follows :

The percentage of the amount Marwan pays

= $100\% + 14\% = 114\%$

So : $\frac{114}{100} = \frac{\text{The amount paid}}{540}$

The amount paid = $\frac{114 \times 540}{100}$
= 615.6 LE

Short answer

Original price : Tax rate : The price after tax

100 % : 14 % : 114 %

540 : ? : ?

The tax value = $\frac{540 \times 14}{100} = 75.6 \text{ LE}$

The amount Marwan pays = $540 + 75.6 = 615.6 \text{ LE}$

also the amount Marwan pays can be directly

calculated as follow : $\frac{540 \times 114}{100} = 615.6 \text{ LE}$

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Ex.1) Answer the following :

- 1  **E-commerce** : An online store receives a commission rate of 1.5 % for marketing seller products. If the store sold products for 42,000,000 LE within a week , calculate the total commission amount for this week.
- 2 If the price of a dress is 340 LE , and during the sale a discount rate is 35 % was applied , what is the new selling price ?
- 3  **Shopping** : Mariam wants to buy a vacuum for 6,800 LE. If the discount rate is 12 % , find what Mariam will pay to buy the vacuum.
- 4  A store offers a 20 % discount rate on all item.
What is the sale price of a shirt whose price before discount is 420 LE ? 
- 5  If a TV price after deduction rate of 16 % is 12,600 LE , what is the TV price before deduction ?
- 6  If a jacket costs 498 LE after a 17 % discount rate of its original price , find the original price. 
- 7  A meal costs 150 LE , and 18 % of the cost is added as the meal's profit. What is the meal's sale price ?
- 8  Omar subscribed to a home internet service for 520 LE per month , along with a 14 % tax rate applied to the service fee. What is the tax value and the total monthly subscription cost that Omar pays ?
- 9  If a car tyre costs 3,200 LE , how much is it after adding a 10 % tax rate ?
- 10 What is the new price of a bag of sugar if its original price is 25 LE and the percentage of increase is 20 % ?

SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

- | | |
|--|--|
| <p>1 If an item price was reduced from 1,500 LE to 1,200 LE , what is the deduction rate ?</p> <p>(a) 3 % (b) 15 %
(c) 20 % (d) 30 %</p> | <p>2 If the price of a car increases from 240,000 LE to 300,000 LE , what is the rate of increase ?</p> <p>(a) 25 % (b) 60 %
(c) 5 % (d) 30 %</p> |
| <p>3 A box contains 240 colored balls , 35 % of which are yellow. How many yellow balls are there ?</p> <p>(a) 4 balls (b) 120 balls
(c) 71 balls (d) 84 balls</p> | <p>4 Mohamed's balance is 450,000 LE. If the Zakat on his wealth is 2.5 % , what is the remaining amount after paying Zakat ?</p> <p>(a) 475,000 LE (b) 438,750 LE
(c) 11,250 LE (d) 461,250 LE</p> |
| <p>5 A hall can accommodate 160 people. If 75 % of its seats are filled , how many people are in the hall ?</p> <p>(a) 40 people (b) 200 people
(c) 120 people (d) 100 people</p> | <p>6 If the price of a mobile phone is 6,500 LE and a 20 % discount is applied , what is the new selling price ?</p> <p>(a) 1,300 LE (b) 7,800 LE
(c) 5,700 LE (d) 5,200 LE</p> |
| <p>7 Ahmed has a meal in a restaurant , the price of the meal is 60 LE with an additional 14 % tax rate. What is the amount Ahmed pays ?</p> <p>(a) 8.4 LE (b) 68.4 LE
(c) 51.6 LE (d) 16.8 LE</p> | <p>8 Hossam bought a computer for 18,000 LE after receiving a 10 % discount rate. What was the price of the computer before the discount ?</p> <p>(a) 17,000 LE (b) 19,000 LE
(c) 20,000 LE (d) 25,000 LE</p> |
| <p>9 Due to the increase of prices , the price of an apartment is increased to 750,000 LE , that is after increasing 25 % . What was the price of the apartment before the increase ?</p> <p>(a) 600,000 LE (b) 700,000 LE
(c) 800,000 LE (d) 900,000 LE</p> | <p>10 Mahmoud uses 15 liters of water in washing dishes. If he wants to reduce the amount by the rate of 20 % , how many liters will he use ?</p> <p>(a) 12 liters (b) 14 liters
(c) 16 liters (d) 18 liters</p> |

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Lesson 5: Sets and their operations

Concept of a Set

A set is a collection of well-defined objects , which are completely determined.
These objects are called the elements of the set.

For example : Each of the following represents a set :

- The Pyramids of Giza with elements Khufu - Khafre - Menkaure.
- The factors of number 6 with elements 1 , 2 , 3 , 6

The previous examples represent sets because their elements are well-defined and known to everyone without dispute.

For example : Each of the following does not represent a set :

- Beautiful flowers.
- Small animals.

The previous examples do not represent sets because their elements are not well-defined and may vary from person to another.

Example ①

Determine which of the following is a set and which is not.

If it is a set , list its elements :

- 1 Days of the week.
- 2 The smart students in your class.
- 3 The prime factors of number 14

Solution

- 1 Set and its elements: Saturday , Sunday , Monday , Tuesday , Wednesday , Thursday , Friday.
- 2 Not a set.
- 3 Set and its elements : 2 , 7

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Expressing a Set

A set can be expressed in the following ways :

1 Listing Method :

To express a set using the listing method , write all its elements between braces $\{ \}$, separated by commas , without repeating elements , and the order does not matter.

2 Set-Builder Method :

To express a set using the set-builder method , identify the property that characterizes the elements of the set.

3 Venn Diagram :

To express a set using a Venn diagram, list the elements of the set and place a dot or an $\times$ next to each element , and enclose them in a circle , square , triangle , or any closed geometric shape. These shapes are called Venn diagrams , named after the English mathematician John Venn.

For example : $A =$ The set of digits of the number 3454

Using the listing method

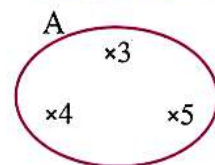
$$A = \{3, 4, 5\}$$

Using the set-builder method

$$A = \{x : x \in \mathbb{N}, x \geq 3, x < 6\}$$

Where $\mathbb{N}$ is the set of natural numbers.

Venn Diagram

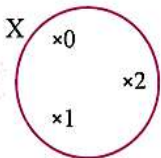


Example 2

Express each of the following sets :

1 $A = \{x : x \in \mathbb{N}, x < 5\}$

using the listing method

2  using set-builder method.

3 $B = \{2, 4, 6, 8\}$ using a Venn diagram.

Note

- The symbol $\in$ denotes that an element belongs to a set and is read as "belongs to."

For example : $3 \in \{7, 3, 5\}$

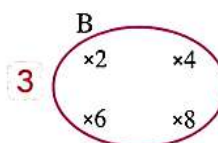
- The symbol $\notin$ denotes that an element does not belong to a set and is read as "does not belong to."

For example : $7 \notin \{5, 3, 0\}$

Solution

1 $A = \{0, 1, 2, 3, 4\}$

2 $X = \{x : x \in \mathbb{N}, x \leq 2\}$



SIMPLEST MATHS BOOKLETS

Types of Sets

1 Finite Set :

A set that contains a finite number of elements

For example :

$$X = \{1, 2, 7, 9\}$$

is a finite set , the number of its elements = 4

2 Infinite Set :

A set that contains an infinite number of elements

For example :

$$X = \{1, 2, 3, 4, \dots\}$$

is an infinite set .

3 Empty Set :

A set that contains no elements , denoted by $\{\}$ or $\emptyset$ and is read as "phi."

For example :

The set of integers between 7 and 8 is an empty set.

Example ③

Determine the type of each of the following sets :

- 1 $A =$ The set of digits of the number 3508.
- 2 $\{0, 2, 4, 6, 8, \dots\}$
- 3 The set of natural numbers less than zero.

Notes

- ① $\{0\}$ is not an empty set
- ② The empty set « $\emptyset$ » is a finite set with number of elements = 0

Solution

1 Finite set.

2 Infinite set.

3 Empty set.

Inclusion (Subset) :

If all elements of set A are existing in set B , then set A is a subset of set B , or set A is included in set B.

For example : If $A = \{1, 4\}$ and $B = \{1, 2, 3, 4\}$

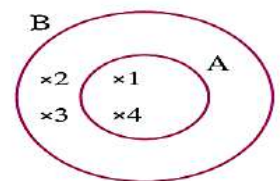
Then : $1 \in A, 1 \in B$ and $4 \in A, 4 \in B$

So that every element from the set A belongs to set B

so we say that set A is subset of set B and is written $A \subset B$

and is read : A is subset of B or A is included in B

and both of set A and B can be represented in the opposite figure.



Notes

- ① The empty set $\emptyset$ is a subset of any set.
For example : $\emptyset \subset \{a, b, c\}$, $\emptyset \subset \{1, 2\}$
- ② Any set is a subset of itself. **For example :** $X \subset X$, $\{1, 2\} \subset \{2, 1\}$

Important Notes

- ① The set $\emptyset$ and the set itself are considered improper subsets.
- ② The number of subsets of a set contains an n-elements equals 2^n
For example : A set contains 3 elements has $2^3 = 8$ subsets

SIMPLEST MATHS BOOKLETS

Equality of Two Sets

If every element of set A belongs to set B , and every element of set B belongs to set A

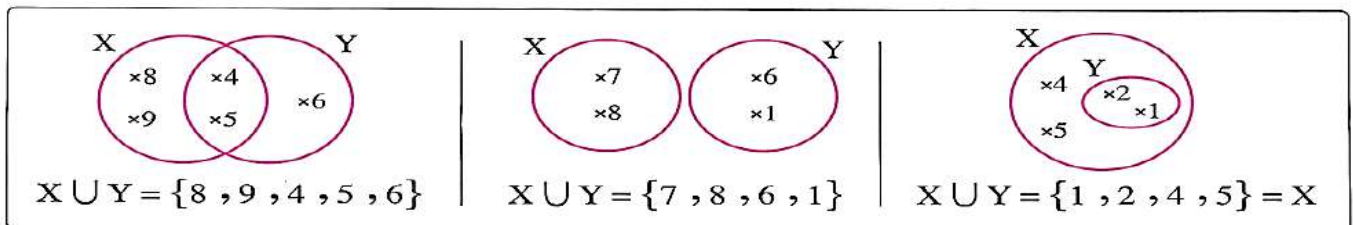
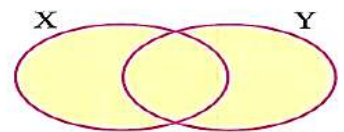
Therefore : $A = B$

For example : If $A = \{5, 2, 4\}$ and $B = \{2, 4, 5\}$, then $A = B$

Operations on Sets (Union - Intersection)

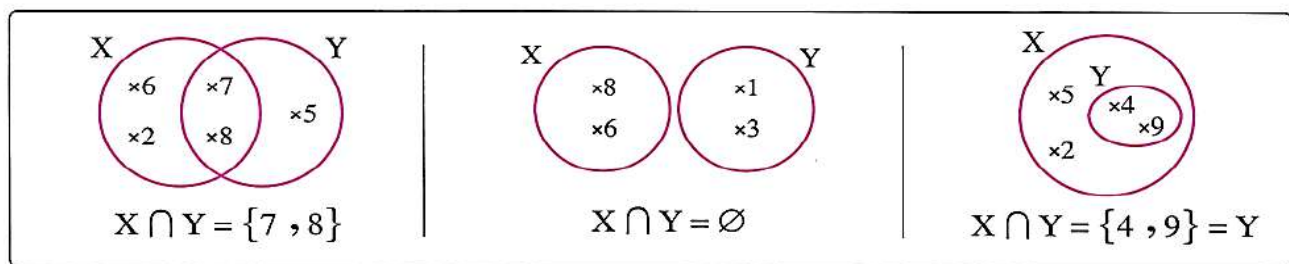
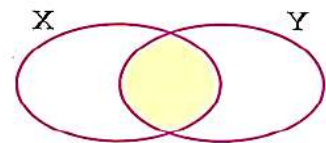
First The Union of Two Sets

$X \cup Y$ is the set of all elements that belong to either set X or set Y



Second The Intersection of Two Sets

$X \cap Y$ is the set of all elements that are common to both sets X and Y



Important Notes

• For any two sets A and B :

① If $A \subset B$, then $A \cap B = A$ and $A \cup B = B$

② $A \cup \emptyset = A$ and $A \cap \emptyset = \emptyset$

③ If $A = B$, then $A \cup B = A$ or B
 , and $A \cap B = A$ or B

• If A and B are two non-empty sets and $A \cap B = \emptyset$, then the two sets A and B are disjoint (non - intersecting)

SIMPLEST MATHS BOOKLETS

Ex.1) Answer the following :

- 1** Use the listing method to write each of the following sets :
- 1 A is the set of odd natural numbers less than 12
 - 2 C is the set of digits of the number 12332551
 - 3 B is the set of negative integers.
 - 4 $X = \{x : x \in \mathbb{Z}, x > -3\}$ where $\mathbb{Z}$ is the set of integers.
- 2** Find the value of each x and y in each of the following :
- 1 $2 \in \{x, 3\}$
 - 2 $4 \in \{3, y + 1, 5\}$
 - 3 $x - 1 \in \{6\}$
 - 4 $y \in \{2, 3, 5\}$, y is a factor of number 9
 - 5 $x \in \{3, 5, 10\}$, x is a prime factor of number 6
- 3** Find all the subsets of each of the following sets :
- 1 $\{7\}$
 - 2 $\{9, 2\}$
 - 3 $\{2, 3, 5\}$
- 4** Put the suitable symbol of : $\subset, \not\subset, \in, \notin$ in the blank : (where $\mathbb{N}$ is the set of natural numbers, $\mathbb{Z}$ is the set of integers and $\mathbb{Q}$ is the set of rational numbers)
- 1 $\{2, 3\} \dots \{1, 2, 3\}$
 - 2 $\{1, 2\} \dots \{2, 3, 4\}$
 - 3 $b \dots \{b, c\}$
 - 4 $0 \dots \emptyset$
 - 5 $\emptyset \dots \{7, 9\}$
 - 6 $\{0\} \dots \emptyset$
- 5** From the opposite Venn diagram, find :
- 1 $A \cap B$
 - 2 $B \cup C$
 - 3 $A \cap B \cap C$
 - 4 $A \cup (B \cap C)$
-
- 6** From the opposite Venn diagram, find :
- 1 $A \cap B$
 - 2 $A \cup C$
 - 3 $A \cap B \cap C$
 - 4 $A \cap (B \cup C)$
-
- 7** If $A = \{5, 2, 3, 7\}$, $B = \{4, 5, 7\}$, and $C = \{7, 2\}$, find :
- 1 $A \cap B \cap C$
 - 2 $A \cup B \cup C$
 - 3 $(A \cup B) \cap C$
- 8** Complete :
- 1 If $A \subset B$, then $A \cap B = \dots$, $A \cup B = \dots$
 - 2 If $A = B$, then $A \cap B = \dots$, $A \cup B = \dots$

SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

- | | |
|--|---|
| <p>1 If $x \in \{2, 5, 8\}$, then what is the value that cannot be x ?
 (a) 2 (b) 3 (c) 5 (d) 8</p> | <p>2 If $x \notin \{3, 4, 1\}$, then which of the following can be x ?
 (a) 1 (b) 2 (c) 3 (d) 4</p> |
| <p>3 If $A = \{2, 5, 8\}$, then which of the following is correct ?
 (a) $\{2\} \in A$ (b) $\{3\} \notin A$
 (c) $\{5\} \subset A$ (d) $\{5, 8\} \not\subset A$</p> | <p>4 If $A = \{4, 2, 7\}$, and $B \subset A$, then which of the following can be the set B ?
 (a) $\{4, 6\}$ (b) $\{1, 3, 5\}$
 (c) $\{4, 3, 7\}$ (d) $\{7, 2\}$</p> |
| <p>5 If $A = \{8, 9, 6\}$, and $B = \{2, 6, 7\}$, then which set expresses $A \cup B$?
 (a) $\{6\}$ (b) $\{2, 7\}$
 (c) $\{8, 9\}$ (d) $\{2, 6, 7, 8, 9\}$</p> | <p>6 If $A = \{8, 9, 6\}$, and $B = \{2, 6, 7\}$, then which set expresses $A \cap B$?
 (a) $\{6\}$ (b) $\{2, 7\}$
 (c) $\{8, 9\}$ (d) $\{2, 6, 7, 8, 9\}$</p> |
| <p>7 If $A = \{5, 7\}$, then what is the number of all subsets of set A ?
 (a) 2 (b) 4 (c) 6 (d) 8</p> | <p>8 If $\{3, 6, 7, x\} = \{6, y, 3, 5\}$, then what is the value of $y - x$?
 (a) -12 (b) -2 (c) 2 (d) 12</p> |
| <p>9 If $x \in \{2, 5\} \cap \{5, 7, 8\}$, then $x =$
 (a) 2 (b) 5 (c) 7 (d) 8</p> | <p>10 If $\{x + 1, 3\} \cup \{1, 2\} = \{1, 2, 3\}$, then x may be equals
 (a) 1 (b) 5 (c) 7 (d) 8</p> |
| <p>11 $\mathbb{Z} \cup \mathbb{N} =$
 (a) $\mathbb{N}$ (b) $\mathbb{Z}$ (c) $\mathbb{Q}$ (d) $\emptyset$</p> | <p>12 $\mathbb{Q} \cup \mathbb{Z} =$
 (a) $\emptyset$ (b) $\mathbb{Z}$ (c) $\mathbb{N}$ (d) $\mathbb{Q}$</p> |
| <p>13 Creative Thinking : The number of subsets of any set cannot be
 (a) 16 (b) 36 (c) 64 (d) 128</p> | <p>14 Creative Thinking : If the number of elements of $A \cup B$ is 5, then the number of elements of A cannot be
 (a) 3 (b) 4 (c) 5 (d) 6</p> |
| <p>15 Creative Thinking : If the number of elements of $A \cap B$ is 5, then the number of elements of A cannot be
 (a) 4 (b) 5 (c) 6 (d) 11</p> | <p>16 Creative Thinking : If the number of elements of $A \cup B$ is 5, and the number of elements of B is 3, then the smallest number of elements of A is
 (a) 1 (b) 2 (c) 3 (d) 4</p> |

SIMPLEST MATHS BOOKLETS

Lesson 6: Operations on integers

Operations on Integers

- 1 Addition. 2 Subtraction. 3 Multiplication. 4 Division.

1 Addition Operation of Integers

There are several strategies for adding integers.

First : Number Line Strategy

Example ①

Use the number line strategy to find the result of each of the following :

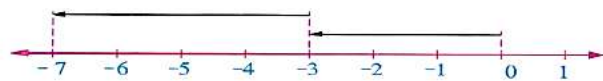
1 $(-3) + (-4)$

2 $(-3) + 5$

- Always Start at 0
- Move to the right to add a positive integer
- Move to the left to add a negative integer

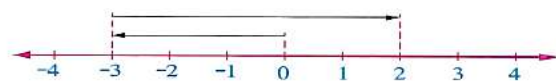
Solution

- 1
- Start at 0
 - Move 3 units left then move 4 units left.



• $(-3) + (-4) = -7$

- 2
- Start at 0
 - Move 3 units left then move 5 units right.



• $(-3) + 5 = 2$

Second : Absolute Value Strategy

Example ②

By using the absolute value strategy ,
find the result of each of the following :

1 $5 + 3$

2 $(-5) + (-3)$

3 $(-5) + 3$

4 $5 + (-3)$

- To add two numbers , having the same sign , add their absolute values , and the result will have the same sign
- To add two numbers having different signs , find the difference between the absolute values of the two numbers , and the result will have the sign of the number that has larger absolute value.

Solution

- 1 Since the two numbers are positive , (they have **same sign**) , so their sum has the same positive sign and **add** their absolute values :

$$5 + 3 = |5| + |3| = 8$$

- 2 Since the two numbers are negative , (they have **same sign**) , so their sum has the same negative sign and **add** their absolute values :

$$(-5) + (-3) = -(|-5| + |-3|) = -8$$

- 3 Since $|-5| > |3|$, The two numbers have **different signs** , so the sum has negative sign , and **find the difference** between their absolute values :

$$(-5) + 3 = -(|-5| - |3|) = -2$$

- 4 Since $|5| > |-3|$, The two numbers have **different signs** , so the sum has positive sign , and **find the difference** between their absolute values :

$$5 + (-3) = (|5| - |-3|) = 2$$

SIMPLEST MATHS BOOKLETS

Properties of Addition Operation in $\mathbb{Z}$

If a , b and c are integers, then :

Property	Example
1 Closure : The sum of any two integers is an integer ($a + b \in \mathbb{Z}$)	$-3 + 5 = 2 \in \mathbb{Z}$
2 Commutative : $a + b = b + a$	$7 + (-6) = (-6) + 7$
3 Associative (Grouping) : $(a + b) + c = a + (b + c)$	$[(-3) + 4] + 2 = (-3) + [4 + 2]$
4 Additive Identity (0) : $a + 0 = 0 + a = a$	$(-7) + 0 = 0 + (-7) = -7$
5 Additive Inverse : For every integer "a" there is an additive inverse "- a" such that : $a + (-a) = 0$	$0 = 5 + (-5) = (-5) + 5$

Example ③

Use the properties of addition in $\mathbb{Z}$ to find the result of each of the following :

1 $8 + 10 + (-8)$

2 $24 + (-19) + (-24) + 9$

Solution

1 $8 + 10 + (-8)$

$= 8 + (-8) + 10$ (Commutative property)

$= (8 + (-8)) + 10$ (Associative property)

$= 0 + 10$ (Additive inverse)

$= 10$ (Additive identity)

2 $24 + (-19) + (-24) + 9$

$= 24 + (-24) + (-19) + 9$ (Commutative property)

$= (24 + (-24)) + ((-19) + 9)$ (Associative property)

$= 0 + (-10)$ (Additive inverse)

$= -10$ (Additive identity)

2 Subtraction Operation of Integers

The subtraction of b from a is the same as the addition of a to the additive inverse of b :

$$a - b = a + (-b)$$

For example :

Subtracting (-2) from 8 can be illustrated in the opposite figure.



Example ④

Use the number line to find the result of each of the following :

1 $5 - 6$

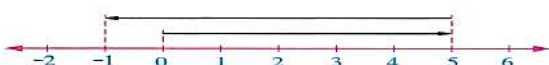
2 $-3 - (-4)$

Solution

1 $5 - 6 = 5 + (-6)$

• Start at 0

• Move 5 units to the right then 6 units to the left



$5 - 6 = 5 + (-6) = -1$

2 $-3 - (-4) = -3 + 4$

• Start at 0

• Move 3 units to the left then 4 units to the right



$-3 - (-4) = -3 + 4 = 1$

SIMPLEST MATHS BOOKLETS

Properties of Subtraction Operation in $\mathbb{Z}$

- $\mathbb{Z}$ is closed under subtraction i.e. The result of subtracting any two integers is also an integer.
- Subtraction in $\mathbb{Z}$ is not commutative or associative.

So that : $3 - 5 \neq 5 - 3$, $7 - (5 - 2) \neq (7 - 5) - 2$

$$\begin{array}{r} 7 \\ - 3 \\ \hline 4 \end{array} \quad \begin{array}{r} 2 \\ - 2 \\ \hline 0 \end{array}$$

- There is no identity element for subtraction in $\mathbb{Z}$, and therefore , there are no inverses for numbers in subtraction within $\mathbb{Z}$

3 Multiplication Operation of Integers

Multiplication is defined as a repeated addition.

Example 5

Find the result of each of the following using the number line strategy :

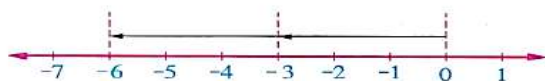
1 $2 \times (-3)$

2 $(-2) \times 4$

Solution

1 $2 \times (-3) = (-3) + (-3)$

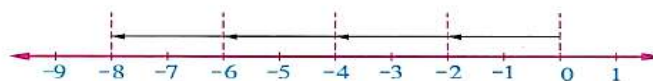
- Start at 0 then move 3 units to the left twice



$$2 \times (-3) = -6$$

2 $(-2) \times 4 = (-2) + (-2) + (-2) + (-2)$

- Start at 0 then move 4 units to the left four times



$$(-2) \times 4 = -8$$

Example 6

Find the result of each of the following :

1 $(-7) \times (-1)$

2 $5 \times (-2)$

3 $0 \times (-7)$

4 $2 \times |-4|$

5 $-|-3| \times 5$

■ The rule of signs in multiplication

- The product of two numbers having the same sign is positive.
- The product of two numbers having different signs is negative.
- The product of a number by zero is zero

Solution

1 $(-7) \times (-1) = 7$

2 $5 \times (-2) = -10$

3 $0 \times (-7) = 0$

4 $2 \times |-4| = 2 \times 4 = 8$

5 $-|-3| \times 5 = -3 \times 5 = -15$

SIMPLEST MATHS BOOKLETS

Properties of Multiplication Operation in $\mathbb{Z}$

If a , b and c are integers, then :

Property	Example
1 Closure : The product of any two integers is an integer ($a \times b \in \mathbb{Z}$)	$2 \times (-7) = -14 \in \mathbb{Z}$
2 Commutative : $a \times b = b \times a$	$(-7) \times 2 = 2 \times (-7)$
3 Associative (Grouping) : $(a \times b) \times c = a \times (b \times c)$	$[3 \times 2] \times (-4) = 3 \times [2 \times (-4)]$
4 The multiplicative identity (1) : $a \times 1 = 1 \times a = a$	$(-7) \times 1 = 1 \times (-7) = -7$
5 The distributing of multiplication on addition and subtraction : $a \times (b + c) = a \times b + a \times c$ $a \times (b - c) = a \times b - a \times c$	$2 \times (-4 + 7) = 2 \times (-4) + 2 \times 7$

Example 7

Use the properties of multiplication in $\mathbb{Z}$ to find the result of each of the following :

1 $(-4) \times 57 \times (-25)$

2 $8 \times 2 \times 125 \times (-50)$

Solution

$$\begin{aligned} 1 \quad & (-4) \times 57 \times (-25) \\ &= (-4) \times (-25) \times 57 \text{ (Commutative property)} \\ &= ((-4) \times (-25)) \times 57 \text{ (Associative property)} \\ &= 100 \times 57 = 5,700 \text{ (Closure property)} \end{aligned}$$

$$\begin{aligned} 2 \quad & 8 \times 2 \times 125 \times (-50) \\ &= 8 \times 125 \times 2 \times (-50) \text{ (Commutative property)} \\ &= (8 \times 125) \times (2 \times (-50)) \text{ (Associative property)} \\ &= 1000 \times (-100) \\ &= -100,000 \text{ (Closure property)} \end{aligned}$$

Example 8

Use the distributive property to find the value of each of the following :

1 $5 \times 7 + 5 \times (-7)$

2 $8 \times 2 - 8 + 8 \times 9$

3 $(-23) \times 99$

4 17×102

Solution

$$\begin{aligned} 1 \quad & 5 \times 7 + 5 \times (-7) = 5 \times (7 + (-7)) \\ &= 5 \times 0 = 0 \end{aligned}$$

$$\begin{aligned} 2 \quad & 8 \times 2 - 8 + 8 \times 9 = 8 \times 2 - 8 \times 1 + 8 \times 9 \\ &= 8 \times (2 - 1 + 9) \\ &= 8 \times 10 = 80 \end{aligned}$$

$$\begin{aligned} 3 \quad & (-23) \times 99 = (-23) \times (100 - 1) \\ &= (-23) \times 100 - (-23) \times 1 \\ &= -2,300 - (-23) \\ &= -2,300 + 23 = -2,277 \end{aligned}$$

$$\begin{aligned} 4 \quad & 17 \times 102 = 17 \times (100 + 2) = 17 \times 100 + 17 \times 2 \\ &= 1,700 + 34 = 1,734 \end{aligned}$$

SIMPLEST MATHS BOOKLETS

4 Division Operation of Integers

The possibility of division in $\mathbb{Z}$

- $6 \div 2 = 3$ because $2 \times 3 = 6$
- $-15 \div 3 = -5$ because $3 \times (-5) = -15$
- $18 \div (-9) = -2$ because $(-9) \times (-2) = 18$
- $(-24) \div (-4) = 6$ because $(-4) \times 6 = -24$

However, the result of $5 \div 3$ does not exist in $\mathbb{Z}$ because there is no integer that when multiplied by 3 gives 5 therefore,

The division is not always possible in $\mathbb{Z}$ or $\mathbb{Z}$ is not closed under division.

Properties of Division Operation in $\mathbb{Z}$

- 1 Division is not always possible in $\mathbb{Z}$ or $\mathbb{Z}$ is not closed under division.
- 2 Division is not commutative For example : $6 \div 2 \neq 2 \div 6$
- 3 Division is not associative For example : $(36 \div (-6)) \div 2 = -6 \div 2 = -3$,
 $36 \div ((-6) \div 2) = 36 \div (-3) = -12$
So that : $(36 \div (-6)) \div 2 \neq 36 \div ((-6) \div 2)$

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

1 $4 + (-3) = (-3) + \dots\dots\dots$

3 $-8 + \dots\dots\dots = 0$

5 $0 + \dots\dots\dots = |-7|$

7 $-2 + (\dots\dots\dots + 5) = -2$

9 The additive inverse of 10 is $\dots\dots\dots$

11 If $a = 3$, and $b = -2$, then the value of $3ab$ is $\dots\dots\dots$

12 The multiplicative identity in $\mathbb{Z}$ is $\dots\dots\dots$

2 $A \times (B + C) = \dots\dots\dots + A \times C$

4 $-9 + \dots\dots\dots = -9$

6 $(5 + (-8)) + 7 = 5 + (\dots\dots\dots + 7)$

8 The additive identity in $\mathbb{Z}$ is $\dots\dots\dots$

10 The additive inverse of -7 is $\dots\dots\dots$



SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

- 1** Find the result of each of the following :
- | | | |
|----------------|-----------------|-----------------|
| 1 $6 + (-4)$ | 2 $-4 - 5$ | 3 $-2 + (-1)$ |
| 4 $7 + (-7)$ | 5 $18 - 40$ | 6 $-37 + 59$ |
| 7 $9 - (-105)$ | 8 $-17 - (-24)$ | 9 $-73 - (-73)$ |
- 2** Use the properties of addition in $\mathbb{Z}$ to find the result of each of the following :
- | | |
|-------------------------|---------------------------|
| 1 $-6 + (-13) + 6$ | 2 $-7 + 2 + (-13)$ |
| 3 $5 + (-3) + 7 + (-9)$ | 4 $25 + (-8) + (-25) + 7$ |
- 3** If $a = 15$ and $b = -5$, find the result of each of the following :
- | | |
|-------------|--------------|
| 1 $ 9 - a $ | 2 $ 3 - b $ |
| 3 $a - b$ | 4 $b - (-a)$ |
- 4** Use the number line to find the product of each of the following :
- | | |
|-------------------|-------------------|
| 1 $3 \times (-3)$ | 2 $(-2) \times 4$ |
|-------------------|-------------------|
- 5** Find the result of each of the following :
- | | | |
|-------------------|------------------------|---------------------|
| 1 -3×7 | 2 $(-125) \times (-4)$ | 3 $0 \times (-10)$ |
| 4 $-72 \div (-9)$ | 5 $420 \div (-15)$ | 6 $(-18) \div (-3)$ |
- 6** Use the properties of multiplication in $\mathbb{Z}$ to find :
- | | |
|------------------------------|--|
| 1 $5 \times 17 \times 2$ | 2 $-4 \times (-19) \times 25$ |
| 3 $50 \times (-45) \times 2$ | 4 $4 \times (-5) \times 3 \times (-2)$ |
- 7** If $a = 15$ and $b = -5$, find the result of each of the following :
- | | |
|-----------------|------------------|
| 1 $ 15 \div b $ | 2 $ b \times a $ |
|-----------------|------------------|
- 8** If $x = 3$, $y = -1$ and $z = -2$, find the value of : $(2x \div y) \times 3z$
- 9** If a and b are two integers , such that $a - b = 5$, and $3 - (-b) = -7$, find : $a + b$.

SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

1 Which of the following sums has a positive sign ?

- (a) $19 + (-26)$ (b) $-35 + 17$
(c) $-25 + (-12)$ (d) $40 + (-18)$

3 $15 + 8 - 15 = \dots\dots\dots$

- (a) -15 (b) 8
(c) 15 (d) 23

5 $|-5| + \dots\dots\dots = 0$

- (a) -5 (b) 5
(c) 0 (d) 1

7 If $X = -1$ and $y = 2$, then $X + y = \dots\dots\dots$

- (a) 2 (b) 3
(c) 1 (d) -1

9 $72 \div (-6) = \dots\dots\dots$

- (a) -12 (b) 12
(c) 6 (d) -6

11 $0 \div (-3) = \dots\dots\dots$

- (a) $\frac{1}{3}$ (b) -3
(c) 1 (d) 0

13 If n is a negative integer, which of the following is the greatest ?

- (a) $\frac{n}{3}$ (b) $3n$
(c) $\frac{3}{n}$ (d) $-3n$

2 Which of the following is equivalent to the subtraction operation : $-5 - (-8)$?

- (a) $5 - 8$ (b) $8 - 5$
(c) $5 + 8$ (d) $-5 - 8$

4 $3 - |-3| = \dots\dots\dots$

- (a) 0 (b) 1
(c) 3 (d) 6

6 $4 + (-6) > \dots\dots\dots$

- (a) 2 (b) 0
(c) -2 (d) -4

8 $6 - (-3) = \dots\dots\dots$

- (a) 18 (b) -18
(c) 9 (d) -9

10 If $X = |-2|$ and $y = -3$, then $Xy = \dots\dots\dots$

- (a) -5 (b) 5
(c) 6 (d) -6

12 $0 \times (-1) \times (-2) \times (-99) = \dots\dots\dots$

- (a) -198 (b) 99
(c) 198 (d) 0

14 If $a + b = 0$, where $a \neq b$, then $a \times b \dots\dots\dots 0$

- (a) $<$ (b) $>$
(c) $=$ (d) $\geq$

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Lesson 7: Operations on Rational numbers

The Set of Rational Numbers $\mathbb{Q}$

It is a set of all numbers that can be written in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$

$$\mathbb{Q} = \left\{ \frac{a}{b} : a \in \mathbb{Z}, b \in \mathbb{Z}, b \neq 0 \right\}$$

We know that the set of counting numbers, the set of natural numbers, and the set of integers are all subsets of the set of rational numbers $\mathbb{Q}$

Operations on Rational Numbers

1 Addition.

2 Subtraction.

3 Multiplication.

4 Division.

1 Addition Operation of Rational Numbers

- If $\frac{a}{b}$ and $\frac{c}{b}$ are two rational numbers with equal denominators, then $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$
- If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers with different denominators, then $\frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}$

Example 1

Add :

1 $-\frac{5}{6} + \frac{1}{6}$

2 $\frac{3}{8} + \frac{1}{4}$

3 $3 + \frac{2}{5}$

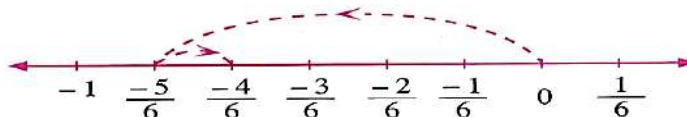
4 $3\frac{1}{4} + (-2\frac{1}{5})$

5 $0.\bar{3} + (-\frac{10}{15})$

Solution

1 $-\frac{5}{6} + \frac{1}{6} = \frac{-5+1}{6} = \frac{-4+2}{6 \div 2} = \frac{-2}{3}$

You can use a number line strategy to find the result



$$-\frac{5}{6} + \frac{1}{6} = \frac{-4}{6} = \frac{-2}{3}$$

2 $\frac{3}{8} + \frac{1}{4} = \frac{3 \times 4 + 1 \times 8}{8 \times 4} = \frac{12+8}{32} = \frac{20}{32} = \frac{5}{8}$

Another solution by using the common denominators :

Since : The LCM of 8 and 4 is 8

Then : $\frac{1}{4} = \frac{1 \times 2}{4 \times 2} = \frac{2}{8}$

Therefore : $\frac{3}{8} + \frac{1}{4} = \frac{3}{8} + \frac{2}{8} = \frac{5}{8}$



Note that

After carrying out the operation of addition, the result should be in its simplest form.

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3 Since : $3 = \frac{15}{5}$ Therefore : $3 + \frac{2}{5} = \frac{15}{5} + \frac{2}{5} = \frac{17}{5}$ | Another Solution : $3 + \frac{2}{5} = 3\frac{2}{5} = \frac{17}{5}$

4 Since : $3\frac{1}{4} = \frac{13}{4}$ and $-2\frac{1}{5} = -\frac{11}{5}$ Therefore : $3\frac{1}{4} + (-2\frac{1}{5}) = \frac{13}{4} + (-\frac{11}{5})$

Since : the LCM of 4 and 5 is 20

Therefore : $\frac{13}{4} + (-\frac{11}{5}) = \frac{65}{20} + (-\frac{44}{20}) = \frac{21}{20} = 1\frac{1}{20}$

Another Solution : $3\frac{1}{4} + (-2\frac{1}{5}) = 3\frac{5}{20} + (-2\frac{4}{20}) = 1\frac{1}{20}$

5 Since : $0.\bar{3} = \frac{1}{3}$ and $-\frac{10}{15} = -\frac{10 \div 5}{15 \div 5} = -\frac{2}{3}$

Therefore : $0.\bar{3} + (-\frac{10}{15}) = \frac{1}{3} + (-\frac{2}{3})$
 $= \frac{1 + (-2)}{3} = -\frac{1}{3}$



Note

The rational number $0.\bar{3}$
 (read as 0.3 recurring)

$$0.\bar{3} = 0.333333\ldots$$

The three dots indicate that the decimal is infinite.

You write on the calculator
 0.3333333333 repeat the digit 3
 till you have full screen of 3s ,
 then press the $=$ key

The calculator will display $\frac{1}{3}$

Notes

• To express the rational number $0.\overline{12}$ in the form $\frac{a}{b}$, write on the calculator : 0.1212121212
i.e. repeat 12 till you have full screen , then press the $=$ key to obtain the number $\frac{4}{33}$

• By using a calculator , you will find that : $0.4444444 = \frac{4}{9}$ Therefore : $0.\bar{4} = \frac{4}{9}$

• By using a calculator , you will find that : $0.1818181818 = \frac{2}{11}$ Therefore : $0.\overline{18} = \frac{2}{11}$

• By using a calculator , you will find that : $0.2132132132 = \frac{71}{333}$ Therefore : $0.\overline{213} = \frac{71}{333}$

The bar over the first digit till the last digit means that these two digits and all digits in between are repeated

• By using a calculator , you will find that : $0.3222222222 = \frac{29}{90}$ Therefore : $0.3\bar{2} = \frac{29}{90}$

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Properties of Addition Operation in $\mathbb{Q}$:

The properties of addition operation in $\mathbb{Q}$ are the same as the properties of addition operation in $\mathbb{Z}$, which are as follows :

- 1 Closure.
- 2 Commutative.
- 3 Associative.
- 4 Existence of Additive Identity(0).
- 5 Existence of Additive Inverse.

Example 2

Use the properties of addition in $\mathbb{Q}$ to find the result of each of the following :

$$\frac{10}{22} + \frac{19}{35} + \left(-\frac{5}{11}\right) + \frac{6}{35}$$

Solution

Since : $\frac{10}{22} = \frac{5}{11}$

Therefore : $\frac{10}{22} + \frac{19}{35} + \left(-\frac{5}{11}\right) + \frac{6}{35}$

$$= \frac{5}{11} + \left(-\frac{5}{11}\right) + \frac{19}{35} + \frac{6}{35} \quad (\text{Commutative property})$$

$$= \left(\frac{5}{11} + \left(-\frac{5}{11}\right)\right) + \left(\frac{19}{35} + \frac{6}{35}\right) \quad (\text{Associative property})$$

$$= 0 + \frac{25}{35} \quad (\text{Additive inverse property})$$

$$= \frac{25}{35} \quad (\text{Additive identity})$$

$$= \frac{5}{7}$$

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2 Subtraction Operation of Rational Numbers

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then subtracting $\frac{c}{d}$ from $\frac{a}{b}$ is adding $\frac{a}{b}$ to the additive inverse of $\frac{c}{d}$

$$\text{i.e. } \frac{a}{b} - \frac{c}{d} = \frac{a}{b} + \left(-\frac{c}{d}\right)$$

Example ③

Find the result of each of the following :

1 $7\frac{2}{5} - 3\frac{1}{4}$

2 $\frac{5}{7} - 1$

3 $-3\frac{1}{2} - 2\frac{1}{4}$

4 $25\% - \left|-\frac{3}{5}\right|$

5 $-0.\bar{3} - \frac{1}{4}$

Solution

1 **Since** : the LCM of the denominators is 20

, then : $7\frac{2}{5} - 3\frac{1}{4} = 7\frac{8}{20} + \left(-3\frac{5}{20}\right) = 4\frac{3}{20}$

2 $\frac{5}{7} - 1 = \frac{5}{7} + \left(-\frac{7}{7}\right) = -\frac{2}{7}$

3 **Since** : the LCM of the denominators is 4

, then : $-3\frac{1}{2} - 2\frac{1}{4} = -3\frac{2}{4} + \left(-2\frac{1}{4}\right) = -5\frac{3}{4}$

4 $25\% = \frac{25}{100} = \frac{1}{4}$, $\left|-\frac{3}{5}\right| = \frac{3}{5}$

$25\% - \left|-\frac{3}{5}\right| = \frac{1}{4} - \frac{3}{5}$, and **Since** : the LCM of the denominators is 20

, then : $\frac{1}{4} - \frac{3}{5} = \frac{5}{20} - \frac{12}{20} = -\frac{7}{20}$

5 $-0.\bar{3} - \frac{1}{4} = -\frac{1}{3} - \frac{1}{4}$, and **Since** : the LCM of the denominators is 12

, then : $-\frac{1}{3} - \frac{1}{4} = -\frac{4}{12} - \frac{3}{12} = -\frac{7}{12}$



Note that

You can skip the step of converting the subtraction to addition



Note that

- $\mathbb{Q}$ is closed under subtraction operation.
i.e. : The result of subtracting any two rational numbers is a rational number.
- Subtraction operation in $\mathbb{Q}$ is not commutative and not associative.
- There is no identity element for subtraction in $\mathbb{Q}$ and hence there are no inverses for the numbers for subtraction in $\mathbb{Q}$

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3 Multiplication Operation of Rational Numbers

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then : $\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$

Example ④

Find the result of each of the following in its simplest form :

1 $\frac{3}{6} \times \frac{2}{5}$

2 $75\% \times (-0.\bar{2})$

3 $-\frac{2}{4} \times 2$

4 $-4\frac{2}{7} \times (-3\frac{1}{6})$

Solution

1 $\frac{3}{6} \times \frac{2}{5} = \frac{3 \times 2}{6 \times 5} = \frac{6}{30} = \frac{1}{5}$

2 $75\% = \frac{75}{100} = \frac{3}{4}$, $-0.\bar{2} = -\frac{2}{9}$

$$75\% \times (-0.\bar{2}) = \frac{3^1}{4^2} \times \left(-\frac{2^1}{9^3}\right) = \frac{1 \times (-1)}{2 \times 3} = -\frac{1}{6}$$

3 $-\frac{2}{4} \times 2 = -\frac{1}{2} \times \frac{2}{1} = -1$

4 $-4\frac{2}{7} \times \left(-3\frac{1}{6}\right) = -\frac{30^5}{7} \times \left(-\frac{19}{6^1}\right)$
 $= \frac{-5 \times (-19)}{7 \times 1} = \frac{95}{7}$



Note that

After multiplying the numbers, you should write the product in its simplest form.



Note that

When multiplying the numbers, you can reduce the numerator of one of the numbers with the denominator of the other.



Note that

It is better to write the rational number in its simplest form to make the operation easier.



Note that

You should convert the mixed number to an improper fraction before carrying out the multiplication operation.

Properties of Multiplication Operation in $\mathbb{Q}$

The properties of multiplication operation in $\mathbb{Q}$ are :

- | | | |
|---|--|----------------|
| 1 Closure. | 2 Commutative. | 3 Associative. |
| 4 Existence of Multiplicative Identity (1). | 5 Existence of Multiplicative Inverse. | |

The multiplicative inverse for $\frac{a}{b}$ is $\frac{b}{a}$ (where : $a \neq 0$)

For example :

- The multiplicative inverse of $\frac{7}{9}$ is $\frac{9}{7}$
- The multiplicative inverse of -7 is $-\frac{1}{7}$ (Note that : $-7 = -\frac{7}{1}$)
- The multiplicative inverse of $-\frac{1}{4}$ is -4
- The multiplicative inverse of $2\frac{1}{3}$ is $\frac{3}{7}$ (Note that : $2\frac{1}{3} = \frac{7}{3}$)



Note that

There is no multiplicative inverse for the number zero because $\frac{1}{\text{zero}}$ is meaningless (undefined).

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6 Property of Distributing Multiplication Over Addition and Subtraction :

If a , b and c are three rational numbers , then :

$$\textcircled{1} a \times (b \pm c) = a \times b \pm a \times c$$

$$\textcircled{2} (b \pm c) \times a = b \times a \pm c \times a$$

Example 6

Use the distributive property to find the value of each of the following :

$$1 \quad \frac{5}{11} \times \frac{1}{7} + \frac{5}{11} \times \frac{6}{7}$$

$$2 \quad \frac{9}{17} \times 21 - \frac{9}{17} \times 4$$

$$3 \quad \frac{22}{25} \times \frac{6}{11} + \frac{5}{11} \times \frac{22}{25} - \frac{22}{25}$$

$$4 \quad \frac{7}{12} \times 5 + \frac{49}{12} - \frac{7}{12} \times 11$$

Solution

$$\begin{aligned} 1 \quad \frac{5}{11} \times \frac{1}{7} + \frac{5}{11} \times \frac{6}{7} &= \frac{5}{11} \times \left(\frac{1}{7} + \frac{6}{7} \right) \\ &= \frac{5}{11} \times \frac{7}{7} \\ &= \frac{5}{11} \times 1 = \frac{5}{11} \end{aligned}$$

$$\begin{aligned} 2 \quad \frac{9}{17} \times 21 - \frac{9}{17} \times 4 &= \frac{9}{17} \times (21 - 4) \\ &= \frac{9}{17} \times 17 = 9 \end{aligned}$$

$$\begin{aligned} 3 \quad \frac{22}{25} \times \frac{6}{11} + \frac{5}{11} \times \frac{22}{25} - \frac{22}{25} \times 1 \\ &= \frac{22}{25} \times \left(\frac{6}{11} + \frac{5}{11} - 1 \right) = \frac{22}{25} \times \left(\frac{11}{11} - 1 \right) \\ &= \frac{22}{25} \times (1 - 1) = \frac{22}{25} \times 0 = 0 \end{aligned}$$

$$\begin{aligned} 4 \quad \frac{7}{12} \times 5 + \frac{49}{12} - \frac{7}{12} \times 11 \\ &= \frac{7}{12} \times 5 + \frac{7}{12} \times 7 - \frac{7}{12} \times 11 \\ &= \frac{7}{12} \times (5 + 7 - 11) = \frac{7}{12} \times 1 = \frac{7}{12} \end{aligned}$$

Another solution :

$$\begin{aligned} \frac{7}{12} \times 5 + \frac{49}{12} - \frac{7}{12} \times 11 \\ &= \frac{7}{12} \times 5 - \frac{7}{12} \times 11 + \frac{49}{12} \\ &= \frac{7}{12} \times (5 - 11) + \frac{49}{12} \\ &= \frac{7}{12} \times (-6) + \frac{49}{12} \\ &= -\frac{42}{12} + \frac{49}{12} = \frac{7}{12} \end{aligned}$$

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4 Division Operation of Rational Numbers

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then the division of $\frac{a}{b}$ by $\frac{c}{d}$ is multiplying $\frac{a}{b}$ by the multiplicative inverse of $\frac{c}{d}$

i.e. $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$ where $\frac{c}{d} \neq 0$

Example 6

Find the quotient of each of the following :

1 $-\frac{2}{3} \div \frac{5}{3}$

2 $\frac{3}{7} \div (-8)$

3 $2\frac{1}{5} \div 5\frac{1}{2}$

4 $-0.\overline{54} \div \frac{5}{22}$

Solution

1 $-\frac{2}{3} \div \frac{5}{3} = -\frac{2}{3} \times \frac{3}{5} = -\frac{2}{5}$

2 $\frac{3}{7} \div (-8) = \frac{3}{7} \times \left(-\frac{1}{8}\right) = -\frac{3}{56}$

3 $2\frac{1}{5} \div 5\frac{1}{2} = \frac{11}{5} \div \frac{11}{2} = \frac{11}{5} \times \frac{2}{11} = \frac{2}{5}$

4 $-0.\overline{54} \div \frac{5}{22} = -\frac{6}{11} \times \frac{22}{5} = -\frac{12}{5}$

Example 7

If $x = -\frac{1}{3}$, $y = \frac{3}{4}$ and $z = -3$, find the numerical value of each of the following :

1 $\frac{y}{z}$

2 $\frac{xy}{z}$

3 $\frac{x}{y} - \frac{y}{z}$

Solution

1 $\frac{y}{z} = \frac{3}{4} \div (-3) = \frac{3}{4} \times \left(-\frac{1}{3}\right) = -\frac{1}{4}$

2 $\frac{xy}{z} = \left(-\frac{1}{3} \times \frac{3}{4}\right) \div (-3) = -\frac{1}{4} \div (-3) = -\frac{1}{4} \times \left(-\frac{1}{3}\right) = \frac{1}{12}$

3 $\frac{x}{y} = -\frac{1}{3} \div \frac{3}{4} = -\frac{1}{3} \times \frac{4}{3} = -\frac{4}{9}$

, $\frac{y}{z} = \frac{3}{4} \div (-3) = \frac{3}{4} \times \left(-\frac{1}{3}\right) = -\frac{1}{4}$

$\frac{x}{y} - \frac{y}{z} = -\frac{4}{9} - \left(-\frac{1}{4}\right) = -\frac{16}{36} + \frac{9}{36} = -\frac{7}{36}$

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Ex.1) Complete the following:

1 $\frac{7}{20} = \dots\dots\dots \%$

3 $|-0.4| = \dots\dots\dots \%$

5 $0.\overline{2} = \dots\dots\dots$ (in the form of $\frac{a}{b}$)

7 $0.3\overline{28} = \dots\dots\dots$ (in the form of $\frac{a}{b}$)

9 $\frac{7}{20} = \dots\dots\dots$ (in the decimal form)

11 The additive identity in $\mathbb{Q}$ is

13 The additive inverse of $-\frac{4}{9}$ is

15 The multiplicative inverse of $\frac{3}{7}$ is

17 The multiplicative inverse of $-\frac{4}{9}$ is

2 $\frac{21}{1000} = \dots\dots\dots \%$

4 If $\frac{5}{a}$ is a rational number, then $a \neq \dots\dots\dots$

6 $0.\overline{123} = \dots\dots\dots$ (in the form of $\frac{a}{b}$)

8 $\frac{5}{8} = \dots\dots\dots$ (in the decimal form)

10 $\frac{1}{3} = \dots\dots\dots$ (in the decimal form)

12 The additive inverse of $\frac{3}{7}$ is

14 The additive inverse of -2.3 is

16 $2 \frac{3}{5} \times \dots\dots\dots = 1$

18 The additive inverse of zero is

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Ex.2) Answer the following :

1

Find the result of each of the following :

1 $\frac{2}{7} + \frac{3}{7}$

2 $\frac{5}{8} + \left(-\frac{7}{8}\right)$

3 $\frac{5}{9} + \left|-\frac{4}{9}\right|$

4 $-3.2 + (-1.\bar{3})$

5 $\frac{1}{5} - \frac{2}{3}$

6 $-\frac{2}{5} - \frac{3}{15}$

7 $-2.125 + 2.6 + \left(-7\frac{21}{24}\right)$

8 $-\frac{15}{18} + \frac{12}{16}$

9 $\frac{3}{7} - \left(-\frac{2}{5}\right)$

2

Using the properties of addition in $\mathbb{Q}$, find the result of each of the following in its simplest form :

1 $\frac{3}{4} + \frac{1}{2} + \frac{1}{4}$

2 $\frac{2}{7} + \frac{3}{4} + \frac{5}{7} + \frac{1}{4}$

3

Find the value of X in each of the following :

1 $\frac{-5}{12} - \left(-\frac{7}{6}\right) = \frac{1}{6} + X$

2 $\frac{2}{7} - \left(-\frac{11}{21}\right) = \frac{11}{21} - X$

4

If $X = \frac{5}{6}$, $y = -\frac{1}{3}$ and $z = \frac{1}{2}$, calculate the value of each of the following :

1 $X + z$

2 $X + y$

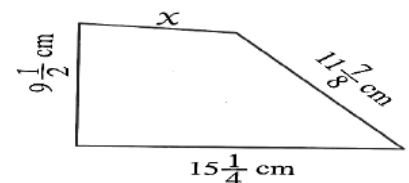
3 $X - y$

4 $(z + y) - X$

5

Geometry :

If the perimeter of the opposite figure is 44 cm, find the value of X in centimeters.



6

Find the result of each of the following in its simplest form :

1 $\frac{3}{5} \times \frac{2}{7}$

2 $-\frac{1}{2} \times \frac{2}{3}$

3 $-\frac{3}{8} \times \left(-\frac{5}{3}\right)$

4 $\frac{5}{27} \div \frac{1}{9}$

5 $\frac{5}{6} \div \left(-\frac{15}{2}\right)$

6 $-\frac{5}{16} \div \left(-\frac{11}{8}\right)$

7

Using the distributive property, find the value of each of the following in its simplest form :

1 $\frac{5}{12} \times 3 + \frac{5}{12} \times 9$

2 $\frac{4}{9} \times 20 - \frac{4}{9} \times 2$

3 $\frac{6}{37} \times 7 + \frac{6}{37} \times 5 + \frac{6}{37} \times (-11)$

4 $\frac{7}{12} \times 5 + 9 \times \frac{7}{12} - 2 \times \frac{7}{12}$

5 $\frac{27}{11} \times \frac{9}{4} - \frac{27}{11} \times \frac{1}{4} + \frac{27}{11} \times 9$

6 $\frac{7}{13} \times 6 + \frac{7}{13} \times 8 - \frac{7}{13}$

8

If $X = \frac{5}{8}$ and $y = \frac{1}{2}$, find the value of : $\frac{X+y}{X-y}$

9

Geometry : Find the area of a triangle with a base length of $\frac{1}{4}$ meter and the corresponding height of $1\frac{1}{2}$ meters.

10

The length of a fabric roll is $7\frac{1}{2}$ meters. If the fabric roll is to be divided into smaller pieces, each of length 30 centimeters, how many pieces will you get ?

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Quiz

Choose the correct answer from the given ones :

1 $\frac{3}{4} + 50\% = \dots\dots\dots$

- (a) 75 % (b) 150 %
(c) $\frac{5}{4}$ (d) $\frac{3}{2}$

2 The result of adding : $\frac{1}{5} + (-\frac{6}{5})$ equals

- (a) 1 (b) - 1
(c) $\frac{7}{5}$ (d) $-\frac{7}{5}$

3 The remainder of subtracting : $\frac{1}{7}$ from $\frac{8}{7}$ equals

- (a) 1 (b) - 1
(c) $-\frac{9}{7}$ (d) $\frac{9}{7}$

4 $\frac{3}{4}$ exceeds $\frac{3}{8}$ by the amount of

- (a) $-\frac{3}{8}$ (b) $\frac{3}{8}$
(c) $-\frac{9}{8}$ (d) $\frac{9}{8}$

5 The additive inverse of the remainder of subtracting : $-\frac{2}{9}$ from $\frac{5}{9}$ is

- (a) $-\frac{7}{9}$ (b) $-\frac{3}{9}$
(c) $\frac{3}{9}$ (d) $\frac{7}{9}$

6 If $a + \frac{6}{7} = 0$, then a =

- (a) zero (b) 1
(c) $\frac{6}{7}$ (d) $-\frac{6}{7}$

7  **Marine Creatures** : A dolphin dived to a depth of $3\frac{1}{4}$ meters underwater , then it dived a further $2\frac{1}{2}$ meters. Which of the following does not express the dolphin's position relative to the water surface ?

- (a) $-3\frac{1}{4} + (-2\frac{1}{2})$ (b) $-3\frac{1}{4} + |-2\frac{1}{2}|$
(c) $-3\frac{1}{4} - 2\frac{1}{2}$ (d) $-(3\frac{1}{4} + 2\frac{1}{2})$

8  **Economy** : If the stock price of a company listed on the Egyptian exchange increased by 3.25 LE , and then if decreased by 2.75 LE , which of the following expresses the change in the stock price at that moment ?

- (a) $-3.25 + 2.75$ (b) $3.25 - 2.75$
(c) $3.25 + 2.75$ (d) $-3.25 - 2.75$

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9 If $\frac{2}{3} \times x = \frac{5}{7} \times \frac{2}{3}$

, then $x = \dots\dots\dots$

- (a) $\frac{2}{3}$ (b) $\frac{5}{7}$
(c) $\frac{3}{2}$ (d) $\frac{7}{5}$

10 If $\frac{2}{5} \div x = \frac{2}{5} \times -\frac{7}{9}$

, then $x = \dots\dots\dots$

- (a) $-\frac{9}{7}$ (b) $-\frac{7}{9}$
(c) $\frac{7}{9}$ (d) $\frac{9}{7}$

11 If three times a number is 27

, then $\frac{1}{3}$ of this number equals $\dots\dots\dots$

- (a) 3 (b) 1
(c) $\frac{3}{2}$ (d) $\frac{9}{4}$

12 Which of the following expressions has the same product as $\frac{-3}{8} \times \frac{8}{3}$?

- (a) $2\frac{1}{4} \times \frac{4}{9}$ (b) $\frac{-2}{5} \times 3\frac{1}{2}$
(c) $-\frac{1}{4} \times (-4)$ (d) $2\frac{1}{2} - 3.5$

13 Which of the following operations has the same result of $2\frac{2}{3} \div (-1\frac{3}{7})$?

- (a) $2\frac{2}{3} \times (-1\frac{7}{3})$ (b) $2\frac{2}{3} \times 1\frac{3}{7}$
(c) $-2\frac{2}{3} \times \frac{7}{10}$ (d) $-1\frac{3}{7} \times 2\frac{2}{3}$

14 What is the multiplicative inverse of $-3\frac{1}{2}$?

- (a) $-\frac{7}{2}$ (b) $-2\frac{1}{3}$
(c) $\frac{-2}{7}$ (d) $\frac{2}{7}$

15 If $\frac{x}{y} = \frac{2}{3}$, then $\frac{3x}{2y} = \dots\dots\dots$

- (a) $\frac{1}{3}$ (b) 1
(c) $\frac{3}{2}$ (d) $\frac{9}{4}$

16 If $\frac{a}{b} = 70$, then $\frac{a}{2b} = \dots\dots\dots$

- (a) 35 (b) 68
(c) 72 (d) 140

17 If $\frac{|x|}{5} = 3$, then $x = \dots\dots\dots$

- (a) 5 (b) 10
(c) 15 (d) ± 15

18 If $(x-1)$ is the multiplicative inverse of $\frac{1}{5}$, then $x = \dots\dots\dots$

- (a) 4 (b) 5
(c) 6 (d) $1\frac{1}{5}$

SIMPLEST MATHS BOOKLETS

Lesson 1

Mathematical Expressions and Formulas / Addition and Subtraction of Algebraic Terms

Unit 2

The Mathematical Expression (Numerical, Algebraic)

The Mathematical Expression

Classified into

Numerical Expression

It consists of one or more numbers with one or more arithmetic operations (+, -, × or ÷)

does not contain any variables

For Examples

- 2
- $3 \times (-6) + 4$
- $7 + 25 \div (-5)$
- $28 \div 7 - 4$

Algebraic Expression

It consists of (one or more variables) or (a combination of numbers and variables) with one or more arithmetic operations (+, -, × or ÷)

contains at least one variable

For Examples

- $3y$
- $5 + 6y - x$
- $n \times \frac{3}{4}$
- $k \div 5 + 3$

The Equation / Inequality / Mathematical Formula

The Equation

It consists of two mathematical expressions with an equal sign (=) between them.

For Examples

- $3x + 1 = 5$
- $n - 1 = 3n$
- $7 - 2 = 5$

The Inequality

It consists of two mathematical expressions with one of inequality sign ($\leq, \geq, >, <$) between them.

For Examples

- $2x < x + 1$
- $2y + 5 \geq 11$
- $5 + 1 > 3$

The Mathematical Formula

It represents a fact, rule or principle using mathematical form such as equation, inequality, or other mathematical forms.

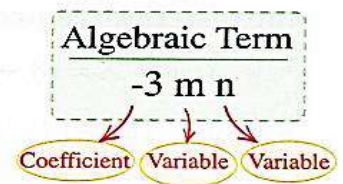
- For Examples :
- Area of a square = side length $\times$ itself
 - Perimeter of a rectangle = $2 \times (\text{length} + \text{width})$
 - $A = S \times S$
 - $P = 2 \times (\ell + w)$

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Algebraic Terms / like Algebraic Terms

The Algebraic Term

An algebraic term is the product (or quotient) of a non-zero number and at least one variable. The number is called the coefficient of the algebraic term.



Like Algebraic Terms

Like algebraic terms are those with the same variables raised to the same powers, even if their coefficients differ.

For Examples :

- Algebraic terms : $-5x^2y$ and $3yx^2$ are like terms because they have the same variables with the same exponents.
- Algebraic terms : $4mn$ and $7m^2n$ are unlike terms because their exponents are different.
- Algebraic terms : $15yz$ and $-5k$ unlike terms because the variables are different.

Addition and Subtraction of Like Terms

- You can add and subtract constant terms as you have learned in adding and subtracting numbers :

$$\bullet -3 + 5 = 2$$

$$\bullet 4 + (-3) = 1$$

$$\bullet 1.5 - 3.2 = -1.7$$

- You can add and subtract like algebraic terms by adding and subtracting their coefficients by using the distributive property :

$$\bullet 8x + 3x = (8 + 3)x = 11x$$

$$\bullet 7y - 9y = (7 - 9)y = -2y$$

$$\bullet -3a - (-5a) = -3a + 5a = (-3 + 5)a = 2a$$

Remember Signs rule	
$\begin{array}{ c } \hline + \\ \hline \end{array} \times \begin{array}{ c } \hline + \\ \hline \end{array} = \begin{array}{ c } \hline + \\ \hline \end{array}$	$\begin{array}{ c } \hline + \\ \hline \end{array} \times \begin{array}{ c } \hline - \\ \hline \end{array} = \begin{array}{ c } \hline - \\ \hline \end{array}$
$\begin{array}{ c } \hline - \\ \hline \end{array} \times \begin{array}{ c } \hline - \\ \hline \end{array} = \begin{array}{ c } \hline + \\ \hline \end{array}$	$\begin{array}{ c } \hline - \\ \hline \end{array} \times \begin{array}{ c } \hline + \\ \hline \end{array} = \begin{array}{ c } \hline - \\ \hline \end{array}$

Notes

There are many verbal expressions that describe the result of subtracting two algebraic terms, such as :

• Subtracting $5x$ from $-3x$

It's written as $\bullet -3x - 5x$

• The increase of $2a$ than $-7a$

It's written as $\bullet 2a - (-7a)$

• The decrease of $2y$ than $8y$

It's written as $\bullet 8y - 2y$

• The term that : if it is added to $3k$, the results is $-4k$

It's written as $\bullet -4k - 3k$

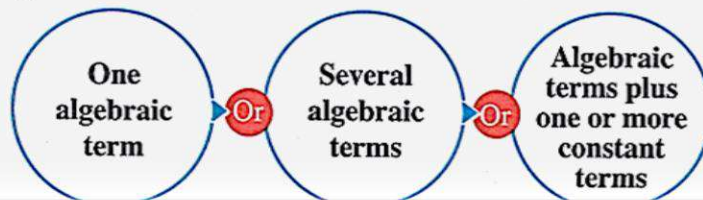
• The term that : if it is subtracted from $5b$, the results is $7b$

It's written as $\bullet 5b - 7b$

SIMPLEST MATHS BOOKLETS

Terms of an Algebraic Expressions

An algebraic expressions consists of :



Examples of Algebraic Expressions

$$2x$$

$$3x - 4y + 5$$

$$8a^2 + 4ab - 3$$

Simplification of Algebraic Expression

To simplify an Algebraic Expression

- 1 Use the distributive property to remove parentheses (if exist).
- 2 Look for like terms and add them.

Simplest Form of an Algebraic Expression

An algebraic Expression is in its simplest form when it does not have any like terms

Example 😊

Simplify each of the following algebraic expressions :

1 $-2x + y - 5 + 3y + 3$

2 $4(-2a + 3b) - 2(8b - 3) + a$

Solution

1 $-2x + y - 5 + 3y + 3$

Find like terms

$$= -2x + y + 3y - 5 + 3$$

Use the commutative property to regroup the like terms.

$$= -2x + (y + 3y) + (-5 + 3)$$

Use the associative property to add the like terms.

$$= -2x + 4y - 2$$

Write the expression in its simplest form.

2 $4(-2a + 3b) - 2(8b - 3) + a$

Use the distributive property.

$= -8a + 12b - 16b + 6 + a$

Find like terms.

$$= -8a + a + 12b - 16b + 6$$

Use the commutative property to regroup the like terms

$$= (-8a + a) + (12b - 16b) + 6$$

Use the associative property

$$= -7a - 4b + 6$$

Write the expression in its simplest form

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 The constant term in the algebraic expression : $2x + 3x - 5$ is
- 2 The number of terms in the algebraic expression : $35abc$ is
- 3 The like term to the term a^2b in the algebraic expression : $b^2a - 3ab + 7ba^2$ is
- 4 The coefficient of the term like to the term $5xy$ from the terms of the algebraic expression : $3yx - 5x^2y + 2xy^2$ is
- 5 $-3y + 5y - 6$ in its simplest form equals
- 6 The result of subtracting $2b$ from $5b$ is
- 7 The algebraic term that , if added to $-7m$, the result will be $-9m$ is
- 8 The algebraic term that , if subtracted from $8x$, the result will be $-4x$ is
- 9 The algebraic term $-3y$ exceeds the algebraic term $2y$ by
- 10 The algebraic term $8k$ is less than the algebraic term $-3k$ by
- 11  $10x + 6y - \dots x + \dots y = 3x + 8y$



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Ex.2) Answer the following :

1

Express each of the following mathematically , stating its type (algebraic expression , equation , inequality , or mathematical formula) :

- 1 Double the number x added to 5 is equal to 1
- 2 The grade x that a student must obtain to pass the test is at least 18.
- 3 The area of a square (A) with side length (ℓ).
- 4 Samer saved x banknotes of 10 LE and y banknotes of 20 LE , then spent 8 LE.
- 5 The speed at which a car can travel on the (Cairo-Alexandria) desert road must not exceed 120 km/h.
- 6 Sally's age 5 years ago , if she is now x years old.
- 7 The arithmetic mean of the two numbers x and y is not less than 18.
- 8 A rectangle with dimensions x and y , whose area is 36 square centimeters.
- 9 The perimeter (p) of a triangle , if the lengths of its sides are a , b and c

2

The algebraic expression $4x + 3y - 8xy - 6$ consist of four terms , write :

- 1 The terms of the expression.
- 2 The constant term.
- 3 The coefficient of x y
- 4 The variable whose coefficient is 3

3

Identify the like terms (if exist) in each of the following groups :

- 1 $2x$, $5y$, $3x$
- 2 a^2 , $-a$, $3a^3$, 5
- 3 $5y$, $3xy$, $-2yx$, $3x$
- 4 $4x$, $5y$, $-3x$, $2y$

4

Find the value of each of the following expressions given that $a = 8$, $b = 3$, $d = 4$, $f = -1$:

- 1 $\frac{-a}{4}$
- 2 $b^2 - 2f$
- 3 $af + 3d$
- 4 $2f - ad$
- 5 $ab - 3fd$
- 6 $2f - 3a + 4b - d$

5

Write the following algebraic expressions in their simplest forms :

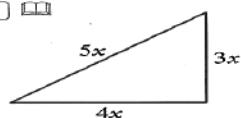
- 1 $7m - 2n - 7m + 1$
- 2 $-x + 2y - 8y + 5x + 7$
- 3 $5k - 3(2k - 4)$
- 4 $-2n + 3(n - 1)$
- 5 $3(2x - 5) - 4(x - 6)$
- 6 $2(3x - 4) - 3(x - 2)$

6



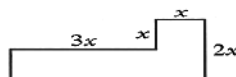
Find the mathematical expression representing the perimeter of each of the following shapes , express it in its simplest form , then find the numerical value of the perimeter at the given variable values :

1



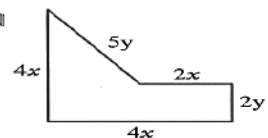
- Mathematical expression :
- Simplest form :
- Numerical value of the perimeter at $x = 1$ is

2



- Mathematical expression :
- Simplest form :
- Numerical value of the perimeter at $x = 5$ is

3

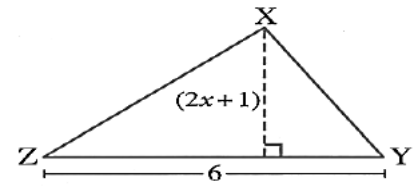


- Mathematical expression :
- Simplest form :
- Numerical value of the perimeter at $x = 3$, $y = 2$ is

SIMPLEST MATHS BOOKLETS

7

Geometry : XYZ is a triangle. Write the mathematical formula expressing its area (A) , then find A at $X = 1$



8

Work : Nada is paid X LE per hour in her job.

Write a mathematical expression for each of the following :

① How much does Nada earn if she works 8 hours ?

② If Nada got a raise of 3 LE per hour , then what would she earn in 5 hours after the new raise?

Quiz

Choose the correct answer from the given ones :

① $a + a + a = \dots\dots\dots$

- (a) $3a^3$ (b) a^3
(c) $3 + a$ (d) $3a$

② $5X + (-3X) = \dots\dots\dots$

- (a) $8X$ (b) $2X$
(c) $-2X$ (d) $-8X$

③ Which of the following pairs of terms are like terms ?

- (a) $2X, -2X^2$ (b) $3a, 8a$
(c) $7X, 7$ (d) X^2, y^2

④ If $a = 2b$ and $b = 15$, then the numerical value of the expression : $a + 2b + 5$ equals

- (a) 40 (b) 60
(c) 30 (d) 65

⑤ What is the mathematical formula representing the area (A) of a parallelogram with a base length (ℓ) and its corresponding height (h) ?

- (a) $A = \frac{1}{2} \ell h$ (b) $A = \ell + h$
(c) $A = \ell h$ (d) $A = \frac{\ell}{h}$

⑥ What is the suitable equation to find the side length of an equilateral triangle whose perimeter is 12 cm ?

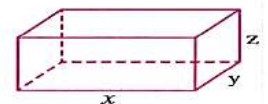
- (a) $X + 3 = 12$ (b) $3X = 12$
(c) $2X = 12$ (d) $X = 12$

⑦ What is the inequality expressing that the suitable height (n) cm of a person should not be less than 180 cm to join one of the sports ?

- (a) $n < 180$ (b) $n > 180$
(c) $n \leq 180$ (d) $n \geq 180$

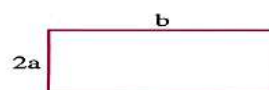
⑧ What is the mathematical formula representing the volume (V) of the following cuboid ?

- (a) $V = 2Xy + 2yz + 2zX$
(b) $V = \frac{1}{2} Xy + z$
(c) $V = Xyz$
(d) $V = 2(X + y)z$



⑨ What is the algebraic expression representing the perimeter of the following rectangle ?

- (a) $b + 2a$
(b) $a + 2b$
(c) $4a + 2b$
(d) $2ab$



⑩ What is the algebraic expression representing the area of the following garden ?

- (a) $5X + 5y$
(b) $3X + 3y$
(c) $8Xy$
(d) $8X + 8y$



SIMPLEST MATHS BOOKLETS

Lesson 2 Addition and Subtraction of Algebraic Expressions

First Addition of Algebraic Expressions

To add the two algebraic expressions : $5x - 7y + 3$ and $2y - 1 - x$, you can use one of the following two methods :

① Using the Horizontal Method

- Write the two expressions on one line with a plus sign (+) between them.

$$(5x - 7y + 3) + (2y - 1 - x)$$

- Use the commutative and associative properties to group like terms together.

$$= (5x - x) + (-7y + 2y) + (3 - 1)$$

- Find the sum $= 4x - 5y + 2$

② Using the Vertical Method

- Write one of the two expressions under the other , and use the commutative property to align like terms vertically

$$\begin{array}{r} 5x - 7y + 3 \\ + \\ -x + 2y - 1 \\ \hline \end{array}$$

- Find the sum $4x - 5y + 2$

The Additive Inverse of Algebraic Expression

It is another algebraic expression whose terms are the additive inverses of the original terms , and the sum of the algebraic expression and its additive inverse equals zero.

Algebraic Expression	$+ 3x - 2y + 7$
	$\begin{array}{c} \downarrow \quad \downarrow \quad \downarrow \\ \text{Reverse the Signs} \end{array}$
Its Additive Inverse	$- 3x + 2y - 7$
The Sum	$0 + 0 + 0 = 0$

Second Subtraction of Algebraic Expressions

Subtraction is defined as adding the additive inverse of the subtrahend to the minuend. Therefore , when subtracting algebraic expressions , you need to find the additive inverse of the subtrahend.

For example :

The Difference

$$\begin{array}{l} 7x - 3x \\ = 4x \end{array}$$

is the same as

The Sum

$$\begin{array}{l} 7x + (-3x) \\ = 4x \end{array}$$

SIMPLEST MATHS BOOKLETS

To subtract the expression : $5x - 3y + 2z$ from the expression : $2y - z + 7x$, you can use one of the following two methods :

① Using the Horizontal Method

- Write the two expressions on one line with the subtraction sign ($-$) between them , starting with the expression to be subtracted from. (minuend).

$$\begin{array}{l} \text{The minuend} \quad - \quad \text{The subtrahend} \\ (2y - z + 7x) - (5x - 3y + 2z) \end{array}$$

- Find the additive inverse of the subtrahend and change the subtraction sign to addition ($+$) .
 $= (2y - z + 7x) (+) (-5x + 3y - 2z)$

- Use the commutative and associative properties to group like terms together.
 $= (2y + 3y) + (-z - 2z) + (7x - 5x)$

- Find the sum $= 5y - 3z + 2x$

② Using the Vertical Method

- Write the subtrahend under the minuend and use the commutative property to align like terms vertically.

$$\begin{array}{r} 2y - z + 7x \\ - \\ -3y + 2z + 5x \end{array}$$

- Find the additive inverse of the subtrahend and change the subtraction sign to addition ($+$) .

$$\begin{array}{r} 2y - z + 7x \\ + \\ +3y - 2z - 5x \\ \hline 5y - 3z + 2x \end{array}$$

- Find the sum

Ex.1) Complete the following:

$$\begin{array}{r} \boxed{1} \quad (+) \quad 7x - 3y + 5 \\ -3x + 4y - 8 \\ \hline \end{array}$$

.....

$$\begin{array}{r} \boxed{2} \quad (+) \quad a - b + 8 \\ -3a + 7b - 13 \\ \hline \end{array}$$

.....

$$\begin{array}{r} \boxed{3} \quad (+) \quad -m + 9n - k \\ -3m - 12n + k \\ \hline \end{array}$$

.....

$$\begin{array}{r} \boxed{4} \quad (+) \quad \dots\dots\dots + 4x - 8y \\ 3z \dots\dots\dots + 3y \\ \hline z \quad \quad + 3x \dots\dots\dots \end{array}$$

$$\begin{array}{r} \boxed{5} \quad (+) \quad \dots\dots\dots \\ 5a - 3b + c \\ \hline -a + b - 2c \end{array}$$

$$\begin{array}{r} \boxed{6} \quad (+) \quad 3k - \dots\dots\dots + 5m \\ \dots\dots\dots - 7l \dots\dots\dots \\ \hline 0 + l - 3m \end{array}$$

SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

1 Find the result of the addition of each of the following :

① $3x - 2y + 5$, $x + 8y - 2$

② $8l - 7m + n$, $-5n + 7m - 2l$

③ $-4a - 3b + 5c$, $-4b - 3a + c$

④ $-6p - 5 + q$, $-4q + 5 - p$

2 Find the result of the subtraction of each of the following :

① $4x - 3$ from $-x + 8$

② $2x + 6y - 7$ from $2x - 5y + 2$

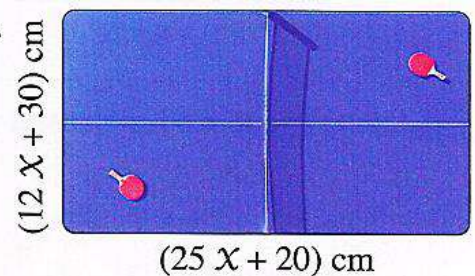
3 What is the increase of the expression : $7a - 8b + 4c$ than $-3a - 5c + b$?

4 What is the decrease of the expression : $-4x - 3y + 8$ than $7 + 3x + y$?

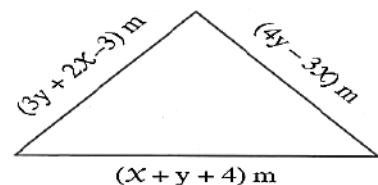
5  **Sport :** The opposite figure shows a table-tennis table.

Write a mathematical expression , in its simplest form , for the table's perimeter , and

then find the value of the perimeter (P) at $x = 10$.



6 The opposite figure shows a fence in the shape of a triangle for a part of a garden. Write a mathematical expression , in its simplest form , that represents the perimeter of the triangle , then find the perimeter (P) at $x = 2$, $y = 3$



7  A person has distributed an amount of money among three other persons. The first person has received $(x + 5)$ LE , the second person has received $(2x + 3)$ LE , and the third person has received $(3x - 1)$ LE. Express in the simplest form the total amount of money has been distributed. If $x = 20$, what is the value of this amount ?

8  **Education :** The number of girls in a school is $(8x + 15)$ and the number of boys is $(7x - 10)$. Write the mathematical expression expresses the increase in the number of girls than the number of boys in this school.

9  Mohammed decided to read a book of $(7x + 31)$ pages. He read $(4x + 17)$ pages over three days. How many pages are left for Mohammed to read to finish the book ?

SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

1 The result of adding the two expressions :

$2x - 1$ and $-3x + 5$ is

- (a) $-5x + 4$ (b) $4 - x$
(c) $x - 4$ (d) $x + 4$

2 The expression : $2x + 3y$ exceeds

$3y - 2x$ by

- (a) $-6y$ (b) $-4x$
(c) $4x$ (d) $6y$

3 The result of adding the two expressions :

$-2y - x - 3z$ and $x + 2y - 3z$ is

- (a) $-6z$
(b) zero
(c) $6z$
(d) $2x - 4y + 6z$

4 The additive inverse of the expression :

$3x - 2y + 8$ is

- (a) $-3x - 2y + 8$
(b) $-3x + 2y + 8$
(c) $-3x + 2y - 8$
(d) $3x + 2y - 8$

5 + $(2x - 3y) = -x + y - 4$

- (a) $x - 2y - 4$
(b) $-3x + 4y + 4$
(c) $-4 - 3x + 4y$
(d) $4y + 3x + 4$

6 $(4x - 3y + 2) - (\text{.....}) = y + x - 5$

- (a) $3x - 4y + 3$
(b) $3x - 4y + 7$
(c) $3y + 4x + 7$
(d) $-2y + 5x - 3$

7 $(\text{.....}) - (a - 3b + c) = -4c - 2b$

- (a) $a - b + 5c$
(b) $-5c + b - a$
(c) $a - b + 5c$
(d) $-3c - 5b + a$

8 $(17 - 3x + 5y) + (\text{.....}) = 15 - y$

- (a) $3x - 2 - 4y$
(b) $-2 - 6y$
(c) $3x - 6y - 2$
(d) $6y + 3x - 2$

SIMPLEST MATHS BOOKLETS

Lesson 3 Linear Equations

Concept of the Equation

An equation is a mathematical statement expressing that two mathematical expressions are equal.

For Example :

• $5x - 3 = 12$ ← Equation

• $2x + 4 - y$ ← Not an equation

• $2b - 3 < 5$ ← Not an equation

• $8 - 2 = 11 - 5$ ← Equation

• An equation can be named according to the number of involving variables (an equation in one variable , two variables , three variables , and so on) and according to the highest integer exponent among its variables.

- For Example :
- If the highest exponent is 1 , it is called **linear**
 - If the highest exponent is 2 , it is called **quadratic**
 - If the highest exponent is 3 , it is called **cubic** , and so on

The equation	Number of variables	The highest exponent for variables	Name of the equation
$2x + 7 = 13$	1	1	Linear in one variable
$3x^2 - 5 = 7$	1	2	Quadratic in one variable
$5x + 3y = 8$	2	1	Linear in two variables
$5y + 3x^3 = 17$	2	3	Cubic in two variables

- Linear equations are represented by a straight line on a graph , and our study will be exclusive to linear equations in one variable.

Forming the Equation

Every situation that can be formulated into an equation involves an unknown number represented by a letter (x , y , z , ...) in addition to constant numbers and operations (+ , - , $\times$, $\div$) with the equality sign (=).

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Solving the Equation

The meaning of solving an equation is to find the value/values of the unknown in the equation , from among a set of alternatives called the substitution set.

The substitution set

The set of potential values for the unknown in the equation.

The solution set

The set of values that belong to the substitution set and satisfy the equality of the two sides of the equation.

Example 😊

Find the solution set of the equation : $2x - 3 = 5$, where the substitution set is $\{3, 4, 5\}$

💡 Solution

The solution set is the set of the values in the substitution set that satisfy the equality of two sides of the equation.

The equation	The substitution set	The left hand side	The right hand side	Are two sides equal ?
$2x - 3 = 5$	At $x = 3$	$2(3) - 3 = 3$	5	✗
	At $x = 4$	$2(4) - 3 = 5$	5	✓
	At $x = 5$	$2(5) - 3 = 7$	5	✗

So That : $x = 4$ is one of the elements of the substitution set and satisfies the equality of two sides of the equation , so the solution set is $\{4\}$.

Note that : the solution set of the equation is a subset of the substitution set.

SIMPLEST MATHS BOOKLETS

Example

Find the solution set in $\mathbb{Z}$ for each of the following equations :

1 $3x + 1 = -4$

2 $\frac{x-3}{2} = -4$

3 $5x - 3 = 2x + 3$

Solution

1

By using the properties of equality

$$3x + 1 = -4$$

(Subtract 1 from both sides)

$$3x + 1 - 1 = -4 - 1$$

$$3x = -5 \quad (\text{Divide both sides by } 3)$$

$$\frac{3x}{3} = \frac{-5}{3}$$

$$x = \frac{-5}{3}$$

The solution set = $\emptyset$

Another solution :

By using the inverse of the mathematical operations

$$3x \text{ (+1)} = -4 \quad (\text{Move with the opposite sign})$$

$$3x = -4 - 1$$

$$(3)x = -5 \quad (\text{Reverse the multiplication})$$

$$x = \frac{-5}{3}$$

The solution set = $\emptyset$

2 $\frac{x-3}{2} = -4$

(Multiply both sides by 2)

$$\frac{x-3}{2} \times 2 = -4 \times 2$$

$$x - 3 = -8 \quad (\text{Add 3 to both sides})$$

$$x - 3 + 3 = -8 + 3$$

$$x = -5$$

The solution set = $\{-5\}$

3 $5x - 3 = (2x) + 3$ (Move with the opposite sign)

$$5x - 2x - 3 = 3$$

$$3x \text{ (-3)} = 3 \quad (\text{Move with the opposite sign})$$

$$3x = 3 + 3$$

$$(3)x = 6 \quad (\text{Reverse the multiplication})$$

$$x = \frac{6}{3}$$

$$x = 2$$

The solution set = $\{2\}$

Example

Find the solution set in $\mathbb{Z}$ and $\mathbb{Q}$ for each of the following equations :

1 $5(x + 4) = 2$

2 $3(x - 4) = 4(2x + 5)$

Solution

1 $5(x + 4) = 2$ (Distribution Property)

$$5x \text{ (+20)} = 2 \quad (\text{Move with the inverse sign})$$

$$5x = 2 - 20$$

$$(5)x = -18 \quad (\text{Reverse the multiplication})$$

$$x = \frac{-18}{5}$$

$$x = -3.6$$

• The Solution set in $\mathbb{Z} = \emptyset$

• The Solution set in $\mathbb{Q} = \{-3.6\}$

Another solution :

$$5(x + 4) = 2$$

(Divide both sides by 5)

$$\frac{5(x+4)}{5} = \frac{2}{5}$$

$$x + 4 = 0.4$$

(Subtract 4 from both sides)

$$x + 4 - 4 = 0.4 - 4$$

$$x = -3.6$$

• The solution set in $\mathbb{Z} = \emptyset$

• The solution set in $\mathbb{Q} = \{-3.6\}$

2 $3(x - 4) = 4(2x + 5)$ (Distribution Property)

$$3x \text{ (-12)} = (8x) + 20 \quad (\text{Move with the inverse sign})$$

$$3x - 8x = 20 + 12$$

$$(-5)x = 32 \quad (\text{Adding the like terms on the same side})$$

$$x = \frac{32}{-5} \quad x = -6.4$$

• The solution set in $\mathbb{Z} = \emptyset$

• The solution set in $\mathbb{Q} = \{-6.4\}$

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 If $X + 3 = 5$, then $X = \dots\dots\dots$
- 2 If $5 - X = 3$, then $X = \dots\dots\dots$
- 3 If $7X = 21$, then $3X = \dots\dots\dots$
- 4 If $3(X - 1) = 9$, then $X = \dots\dots\dots$
- 5 The solution set of the equation : $2X + 1 = 5$ in $\mathbb{Q}$ is.....
- 6 The solution set of the equation : $3X - 1 = 4$ in $\mathbb{N}$ is
- 7 If X is an even integer , then the next even integer is
- 8 The sum of two numbers is 15 ,if one of them is y , then the other is
- 9 A rectangle with a perimeter of 24 cm and length l cm , then its width is cm
- 10 Two integers whose difference is 7 , if the smaller one is m , then the larger one is
- 11 If the perimeter of a square is (P) , then its side length is



SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

1 Represent each of the following situations in the form of a suitable equation :

- ① When 5 is added to a number , the result is (-3)
- ② When 3 is added to a number , the result is 0
- ③ When 15 is subtracted from twice a number , the result is 12
- ④ When (-8) is subtracted from three times a number , the result is (-5)
- ⑤ The sum of three consecutive odd numbers is 87
- ⑥ The sum of two consecutive even numbers is 54

2 Find the solution set for each of the following equations using the given substitution set :

- ① The equation : $y + 1 = -3$, the substitution set : $\{-2, -3, -4\}$
- ② The equation : $7 - k = 2$, the substitution set : $\{3, 4, 5, 6\}$
- ③ The equation : $2x + 1 = 7$, the substitution set : $\{2, 3, 4\}$
- ④ The equation : $3x + 2 = 17$, the substitution set : $\{3, 4, 5, 6\}$

3 Find the solution set of the equation $2x + 7 = 3$, if the substitution set is ① $\mathbb{Z}$ ② $\mathbb{N}$

4 Find the solution set for each of the following equations in $\mathbb{Z}$ and $\mathbb{Q}$:

- | | |
|-----------------|-----------------|
| ① $x + 12 = 7$ | ② $3x + 11 = 9$ |
| ③ $2y - 5 = -2$ | ④ $9 - 2b = 7$ |

5 Find the solution set for each of the following equations in $\mathbb{N}$:

- | | | |
|------------------------------------|----------------|-------------------|
| ① $-\frac{2}{5} + a = \frac{3}{5}$ | ② $4 + 5x = 9$ | ③ $7.4 - y = 2.4$ |
|------------------------------------|----------------|-------------------|

6 Find the solution set for each of the following equations in $\mathbb{Z}$:

- | | | |
|------------------|-----------------|-------------------------|
| ① $2x - 5 = -17$ | ② $4 - 3x = 19$ | ③ $4(x - 1) = 3(x + 1)$ |
|------------------|-----------------|-------------------------|

7 Find the solution set for each of the following equations in $\mathbb{Q}$:

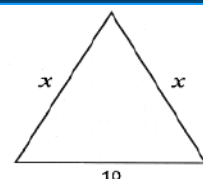
- | | | |
|---------------------------|-------------------------|-----------------------------------|
| ① $3(x - 5) = -18$ | ② $2(x - 3) = 8$ | ③ $2(x + 3) = 3(1 - x)$ |
| ④ $\frac{1}{3}x + 3 = 12$ | ⑤ $2x + 5 = 12 + 3x$ | ⑥ $\frac{x+1}{3} = \frac{x-1}{4}$ |
| ⑦ $3(x - 1) + 4 = 3$ | ⑧ $4(x - 3) = 2(x + 4)$ | |

8 If $\frac{m}{3} = 7$, then what is the value of $m - 19$?

If $-7k = 28$, then what is the value of $3k + 6$?

9 Geometry :

If the perimeter of the opposite triangle equals 34 , then what is the value of x ?



SIMPLEST MATHS BOOKLETS

- 10**  **Sports :** A rectangular-shaped football pitch has a length less than twice its width by 15 meters. If the pitch's perimeter is 330 meters , calculate its dimensions.
- 11**  If my mother's age now is three times my age , and she is also 24 years older than me , how old is each of us now ?

Quiz

Choose the correct answer from the given options :

- | | |
|--|---|
| <p>1  If $2x = 2$, then $(3x - 1) = \dots\dots\dots$</p> <p>(a) 1 (b) 2</p> <p>(c) 3 (d) 4</p> | <p>2  If $4(x + 2) = 12$, and the substitution set is $\{2, 3, 4\}$, then the solution set = $\dots\dots\dots$</p> <p>(a) $\{1\}$ (b) $\{2\}$</p> <p>(c) $\{3\}$ (d) $\emptyset$</p> |
| <p>3  Two consecutive numbers whose sum is 29. Which of the following equations expresses that ?</p> <p>(a) $x + x + 2 = 29$ (b) $x + x + 1 = 29$</p> <p>(c) $x + x - 1 = 28$ (d) $x + x + 1 = 30$</p> | <p>4  Ziad is x years old now. Seven years ago , he was 18 years old. Which of the following equations represents this situation ?</p> <p>(a) $x + 7 = 25$ (b) $x - 7 = 11$</p> <p>(c) $x + 7 = 18$ (d) $x - 7 = 18$</p> |
| <p>5  The solution set in $\mathbb{Z}$ for the equation : $7 - 3x = x - 3$ is $\dots\dots\dots$</p> <p>(a) $\emptyset$ (b) $\{2\}$</p> <p>(c) $\{1\}$ (d) $\{3\}$</p> | <p>6  The solution set in $\mathbb{Q}$ for the equation : $4(x - 8) = 2x + 1$ is $\dots\dots\dots$</p> <p>(a) $\{17\}$ (b) $\emptyset$</p> <p>(c) $\{16\frac{1}{2}\}$ (d) $\{20\}$</p> |
| <p>7  Which of the following represents the solution of the equation : $2(x - 5) = 0$ in $\mathbb{Q}$?</p> <p>(a) 0 (b) 5</p> <p>(c) - 5 (d) 10</p> | <p>8  Which of the following equations does not have a solution in $\mathbb{Z}$?</p> <p>(a) $6x = 12$ (b) $6x = 15$</p> <p>(c) $6x = 18$ (d) $6x = 24$</p> |
| <p>9  Safaa bought three identical suitcases and paid 1500 LE and she got a 300 LE discount. The price of one suitcase before the discount is $\dots\dots\dots$ LE.</p> <p>(a) 500 (b) 600</p> <p>(c) 700 (d) 800</p> | <p>10  If $0.6\overline{x} - \frac{1}{3} = 1$, then what is the value of x ?</p> <p>(a) $\frac{20}{9}$ (b) $\frac{2}{9}$</p> <p>(c) 2 (d) $\frac{1}{2}$</p> |

SIMPLEST MATHS BOOKLETS

Lesson1

Data Organization

Unit 3

Statistics

Statistics is a branch of mathematics that involves collecting , organizing , presenting , analyzing , and interpreting data to make a decision.
It has applications in various fields such as medicine , economics , social sciences , etc.

The Scientific Steps of Statistical Research :

1 Identify the problem or the question :

Formulate it as a statistical question.

2 Collect data :

This can be done using various methods such as observation , survey or interview.

3 Organize and present data :

Use one of the appropriate charts
(dot plot , bar graph , histogram , etc.).

4 Analyze and interpret data.

5 Make prediction and decisions.

Statistical Question : It requires data collection and organization to answer and does not have a specific answer

For example :

- "What is your nationality?" (Not a statistical question).
- "What are the nationalities of visitors to the Grand Egyptian Museum today?" (Statistical question).

Handling raw data without organization or representation does not provide any information or conclusions.

Organizing data and displaying it in diagrams makes it easier to get information and make decisions.

The appropriate diagram is chosen based on the type of data and the purpose of the statistical research.

Bar graph

Example ①

A teacher asked his students inside the class : "What is your favorite hobby?"
The responses were as follows:

Drawing	Singing	Acting	Drawing	Reading	Reading	Acting
Reading	Drawing	Singing	Music	Reading	Singing	Music
Reading	Music	Drawing	Music	Reading	Acting	Music

Represent this data with a bar graph and answer the following:

- 1 What is the hobby which is the largest number of students preferred ?
- 2 What is the hobby which is the least number of students preferred ?
- 3 How many more students prefer music than drawing ?

Solution

Arrange the data in a frequency table , and to make it easier use tally marks as follows :

Hobby	Tally Marks	Frequency
Drawing		4
Acting		3
Reading		6
Singing		3
Music		5

The frequency table can be simplified by removing the tally marks , to get the following frequency table

Hobby	Drawing	Acting	Reading	Singing	Music
Frequency	4	3	6	3	5

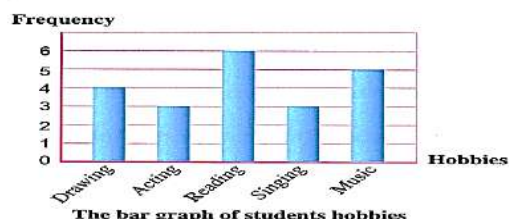
Note that

The Hobbies can be written in the table in any order.

- 1 Reading
- 2 Singing , Acting
- 3 $5 - 4 = 1$

Notes on Bar graph

- Bar graph is used for qualitative or quantitative data.
- There are equal gaps between the bars.
- The bars can be reordered.
- The graph shows the actual data values.



SIMPLEST MATHS BOOKLETS

Dot Plot

Example ②

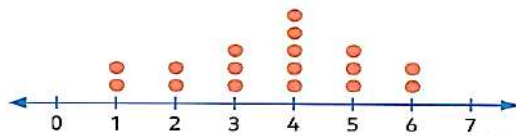
A teacher asked his students : "How many books did you read last year?" The responses were as follows :

1 5 4 4 2 4 3 5 4 4 3 5 1 6 2 3 6

- 1 Represent this data with a dot plot.
- 2 Find the mode.
- 3 Find the median , first quartile and third quartile.
- 4 Draw the box plot.

Solution

1



2 The mode is 4 (as it is the most frequent).

3 • The median is the value in the middle after arranging the data = 4

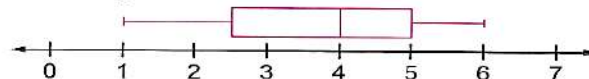
• The first quartile (is the median of values less than 4) = $\frac{2+3}{2} = 2.5$

• The Third quartile (is the median of values greater than 4) = $\frac{5+5}{2} = 5$

4 To draw the box plot , create a summary table of the five values.

Minimum Value	First Quartile	Median	Third Quartile	Maximum value
1	2.5	4	5	6

And from it , we draw the box plot



Notes on Dot Plot

- Dot plot is used to represent quantitative data only.
- Each data point is represented by a dot on a number line.
- The order of the number line is followed.
- The plot shows the actual data values.

Frequency Table with Intervals and its Representation Using Histogram

When the number of data points is large and the values vary over a wide range , when it is organized , it is divided into a suitable number of groups or equal intervals and the number of items belong to each group are determined. Then , a table containing these groups and their corresponding frequencies is created. This is called a frequency table with intervals.

Example ③

The following are the math test marks of students in a class :

8 40 51 45 34 46 36 54 4 56 18
36 45 48 25 47 14 48 50 28 42 55
20 40 37 30 38 46 59 19 23 48 50

- Organize this data and represent it with a histogram.

SIMPLEST MATHS BOOKLETS

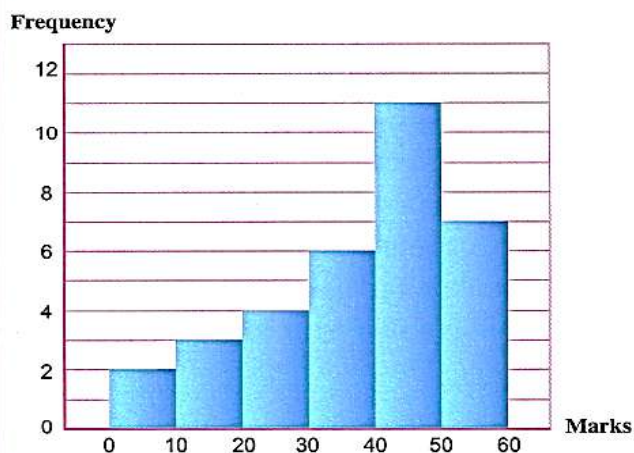
Solution

- To create the frequency table with intervals
- Find the range and it is the difference between the maximum value and the minimum value.
So , the Range : $59 - 4 = 55$
- Divide the data into a suitable number of mark intervals , let's say 6 intervals of 10 marks each , and get the following groups :
- **The first Group :** The students scoring 0 to less than 10 marks and it is written as (0 –)
- **The second Group :** The students scoring 10 to less than 20 marks and it is written as (10 –) and so on till the last group where :
- **The last Group :** The students scoring 50 to less than 60 marks and it is written as (50 –)
Then , create the opposite tally table.

And by removing the tally marks column , the following frequency table is obtained :

The Marks	0 –	10 –	20 –	30 –	40 –	50 –
Frequency	2	3	4	6	11	7

The histogram would be as follows :



The Data is recorded in the following table :

The groups (The marks)	Tally Marks	Frequency
0 –		2
10 –		3
20 –		4
30 –	I	6
40 –	I	11
50 –		7



Notes on Histogram

- Histogram represents only quantitative data.
- The bars have the same width with no gaps between them [unless there is a group with no data].
- Data cannot be reordered.
- The actual data values are not shown.

Notice that from the histogram , you can find :

- Most of the students scores range from 40 to less than 50 marks.
- The number of students scoring less than 30 marks = $2 + 3 + 4 = 9$
- The number of students scoring 40 marks or more = $11 + 7 = 18$

SIMPLEST MATHS BOOKLETS

Stem-and-Leaf Plot

A stem-and-leaf diagram is a way of displaying quantitative data based on place value for every digit in the data values , separating the last digit on the right to form the leaves , and the rest of the digits forming the stem. For example :

If a data point is (143) the units (3) represents the leaf , and the rest of the number (14) represents the stem. The plot is formed by drawing a vertical line , with leaf on the right and the stem on the left , and a key indicating how to read the data.

Examples of Stem-and-Leaf Plots:

Stems	Leaves
5	1 1
6	0 3 5
7	4 6
8	1 9 9

Key 7 | 4 represents 74

Stems	Leaves
12	3 4
13	2 2 6
16	1 8
17	0 4

Key 17 | 4 means 174

Stems	Leaves
15	0 1 1
16	2 3
17	1 2 2
18	5

Key 16 | 2 represents 16.2

Note

If the data includes decimal point like 17.1 , 16.2 , the decimal part (1) , (2) represent the leaves , and the whole number (17) , (16) represent the stems.

In each of the following stem-and-leaf plots :

1

Stems	Leaves
23	2 3
24	1 5 6
25	0 1
26	2 2

Key 23 | 2 represents 232

- Write the data.

2

Stems	Leaves
84	1 1 2
86	2 8
87	0 1 4
88	2 4 6

Key 86 | 2 represents 86.2

- Find the mode , median , first quartil and third quartile.

Solution

1 The data set is

232 233 241 245 246 250 251 262 262

The Mode = 262

The Median = 246

The First quartile = $\frac{233 + 241}{2} = 237$

Third quartile = $\frac{251 + 262}{2} = 256.5$

2 The data set is

84.1 84.1 84.2 86.2 86.8 87 87.1 87.4 88.2 88.4 88.6

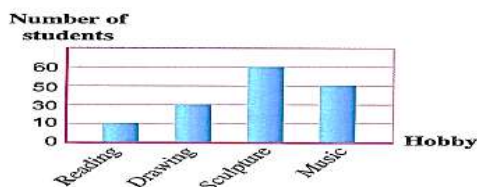
• The Mode = 84.1

The Median = 87

The First quartile = 84.2

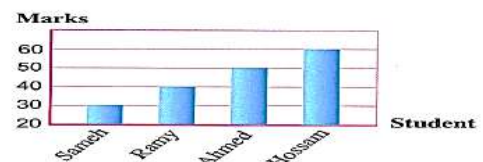
• The Third quartile = 88.2

Examples of Misleading Graphs



"Uneven scale on the vertical axis"

Misleading because it shows that the number of those who chose drawing is twice that of those who chose reading, while it is actually three times.



"The vertical axis does not begin at zero"

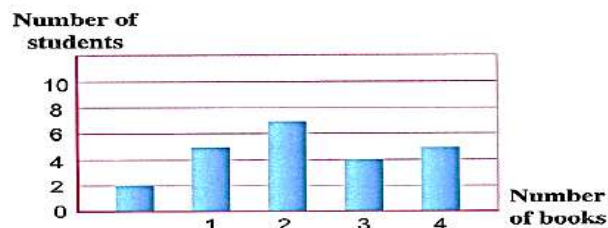
Misleading because it shows that Ramy marks as twice that of Sameh's , which is not true.

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

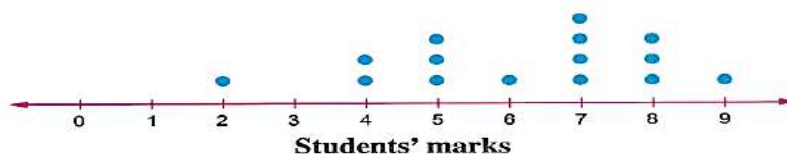
- 1 The opposite bar graph shows the number of books read by your classmates last month :

- The number of students who read three books =
- The number of students who read fewer than three books =
- The total number of students in the class =



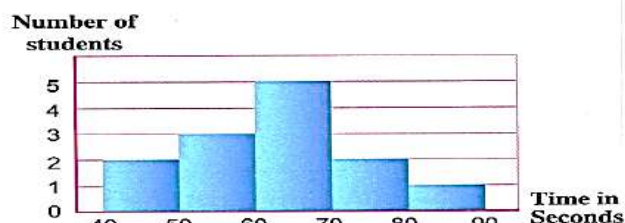
- 2 The teacher recorded the students scores in the math test and represented them with the opposite dot plot :

- The number of students who scored 5 points or more =
- The score that most students received =
- The median =
- The first quartile =
- The third quartile =



- 3 In a running race , the physical education teacher measured the time each student took to finish the race and divided these measurements into intervals in the opposite histogram :

- The number of students who finished the race in less than 60 seconds =
- The number of students who finished the race in 80 seconds or more =
- The interval that contains the largest number of students is
- The total number of students who participated in the race =



- 4 The opposite stem-and-leaf plot represents the total scores of some students :

- The number of students who scored more than 270 points =
- The number of students who scored less than 260 points =

Stems	Leaves
25	3 5
26	0 1 1 3
27	2 3 5
28	8 9

- The mode =
- The median =
- The first quartile =
- The third quartile =

Key 26 | 0 means 260

SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

1

The following data represent laptop sales in a computer shop in six months.

Represent this data in a suitable graphical chart.

July	8
August	6
September	7
October	8
November	8
December	7

2

A teacher recorded the marks of 25 students in a quiz as follows :

6 5 6 3 4 6 7 5 6 3 8 6 6 7 7 6 7 8 4 6 8 7 5 6 5

- 1 Represent this data using a dot plot and a bar graph.
- 2 How many students got at least 7 marks ?
- 3 What is the mark that most students got ?

3

Draw a histogram to represent the following table :

Intervals	1 –	11 –	21 –	31 –	41 –
Frequency	8	12	36	24	20

4

The following data represents the masses in kilograms of a group of 30 students :

70 43 48 72 53 81 76 54 58 64
51 53 75 62 84 67 72 80 88 65
60 43 53 42 57 61 55 75 82 71

- 1 Organize this data in a table using equal intervals (40 – , 50 – , ...)
- 2 Which interval has the greatest number of students ?
- 3 How many students have masses less than 70 kg ?
- 4 Represent the data in a histogram.

5

The opposite stem-and-leaf plot represents the heights of trees , in meters , in the school garden :

- 1 Find the modal height
- 2 Find the median , first quartile , and third quartile.
- 3 Find the range.
- 4 Draw the box plot.

Stems	Leaves
1	9
2	2 8
3	1 4 4 9
4	5 8
5	1 2

Key 1 | 9 means 1.9 meters

SIMPLEST MATHS BOOKLETS

6

If the number of people who went to a restaurant over 11 days is as follows :

104 131 120 115 109 124
128 118 116 120 125

Stems	Leaves
.....	
.....	
.....	
.....	

- 1 Complete the adjacent plot.
- 2 Find : the mode , median , and range.

Key 13 | 1 means 131

7

The following data represents the number of toys sold by a store over 30 days :

13 32 12 33 27 37 44 8 26 32
36 41 45 9 38 16 46 48 29 15
13 32 33 14 18 28 34 25 7 18

Represent this data using a stem-and-leaf plot , then find the median and the mode.

8

Industry : The opposite stem-and-leaf plot displays the average battery lives of 25 smartphones :

- 1 Draw the box plot of this data.
- 2 How many smartphones have an average battery life more than 17 hours?
- 3 Calculate the percentage of smartphones whose average battery life is less than 12 hours.

Stems	Leaves
0	8 9
1	0 1 1 2 2 2 3 4 5 6 7 8 9
2	0 2 5 6 7 8 9 9
3	1 2

Key 3 | 2 means 32 hours

SIMPLEST MATHS BOOKLETS

Quiz

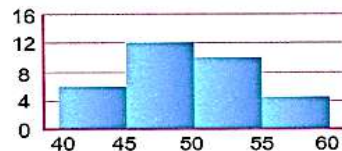
Choose the correct answer from the given ones :

1 Which of the following is suitable for representing categorical data

- (a) Bar graph.
- (b) Histogram.
- (c) Stem-and-leaf plot.
- (d) Both a and b

3 From the following histogram :
The frequency in the 50 – interval is

- (a) 12
- (b) 8
- (c) 10
- (d) 9



2 Which of the following charts does not display the actual data ?

- (a) Dot plot.
- (b) Histogram.
- (c) Stem-and-leaf plot.
- (d) Bar graph.

4 From the opposite stem-and-leaf plot , what is the median ?

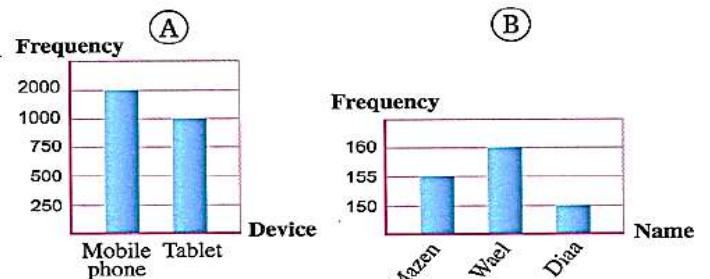
- (a) 16
- (b) 17
- (c) 18
- (d) 20

Stems	Leaves
0	9
1	0 2 2 2 3 4 5 6 6
2	0 1 1 5 7 8 9
3	1 2 3

Key 3 | 1 means 31

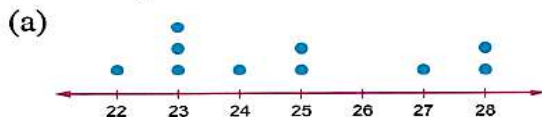
5 One of the following graphs , represents the heights of three friends and the other represents the number of tablets and smartphones owned by the employees of a company. Which of them is misleading ?

- (a) Only A is misleading.
- (c) Both are misleading.



- (b) Only B is misleading.
- (d) Both are not misleading.

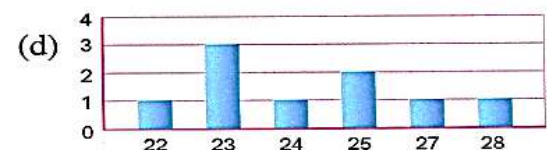
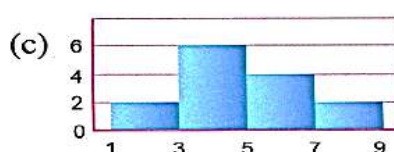
6 If the range is 6 , the median is 24 , which of the following plots satisfies this condition ?



(b)

Stems	Leaves
1	9 9
2	0 1 4
3	2 2 3 5

Key 2 | 4 means 24



SIMPLEST MATHS BOOKLETS

Lesson 2

Arithmetic Mean

Measures of Central Tendency

They are values that describe the center of a data set , such as the arithmetic mean , median , and mode.

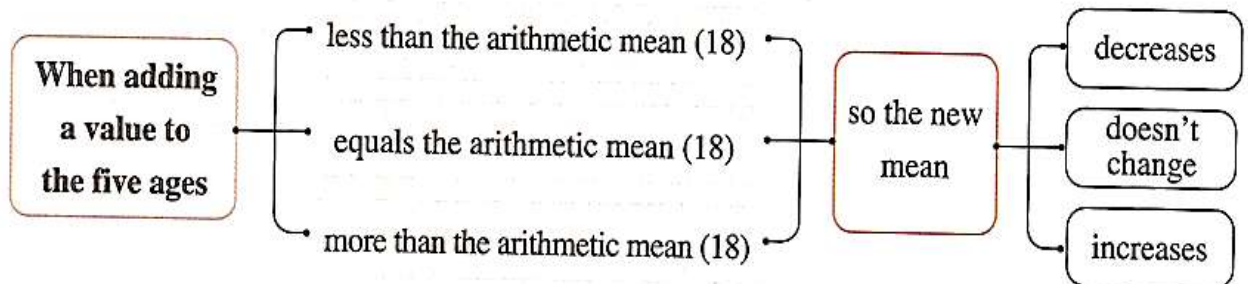
Arithmetic Mean (Average)

The arithmetic mean of a set of values = $\frac{\text{The sum of these values}}{\text{Their number}}$

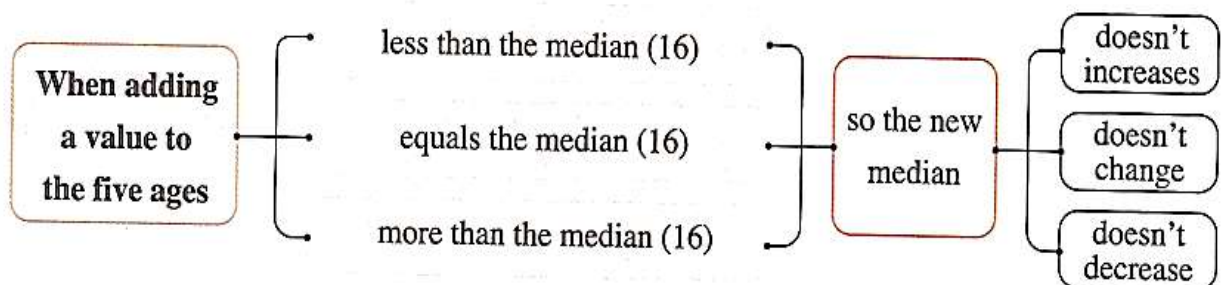
For example : The arithmetic mean of the values 6 , 5 , 11 , 7 equals $\frac{6 + 5 + 11 + 7}{4} = 7.25$

Note

① The arithmetic mean of the five ages = $\frac{15 + 15 + 16 + 21 + 23}{5} = 18$



② The median of the five ages = 16



SIMPLEST MATHS BOOKLETS

The Arithmetic Mean of a Frequency Distribution

You can calculate the arithmetic mean ($\bar{x}$) of a frequency distribution where each value x has a frequency f using the following formula :

$$\text{The arithmetic mean } (\bar{x}) = \frac{\sum (f \cdot x)}{\sum f}$$

Where : $\sum f$ is the sum of the frequencies and $\sum (f \cdot x)$ is the sum of the products of f and x

Example 😊

The following table shows the masses of 30 students in kilograms at a school :

The masses (x)	35	38	42	44	52
Number of students (f)	4	10	8	6	2

Find the arithmetic mean of the mass of the student.

💡 Solution

x	f	$f \cdot x$
35	4	140
38	10	380
42	8	336
44	6	264
52	2	104
Total	30	1224

$$\begin{aligned}\text{The arithmetic mean of the mass of the student} &= \frac{\sum (f \cdot x)}{\sum f} \\ &= \frac{1224}{30} \\ &= 40.8 \text{ kg}\end{aligned}$$

The Misleading Statistical Data

Using the arithmetic mean regardless of the overall distribution of the data can be misleading. If there are some extreme values (very large value or very small value) , this can significantly affect the arithmetic mean. Therefore , in such cases , it is better to use the median or the mode.

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Ex.1) Complete the following:

- 1 The arithmetic mean of the numbers 3 , 0 , 9 , 8 , 5 is
- 2 The arithmetic mean of the numbers x , 1 , 7 , 8 , 9 , 8 , 7 , 2 is 6 , then x equals
- 3 If the arithmetic mean of the values $x + 1$, $x - 3$, 9 , 4 $x + 6$ is 7.25 , then x equals
- 4 The median of the numbers 25 , 15 , 7 , 18 , 17 , 30 is

Ex.2) Answer the following :

1

If the arithmetic mean of the numbers 16 , $n + 3$, 14 , $2n - 2$ is 15.25
Find the median of these numbers.

2

The opposite table shows the number of minutes a group of people spend on phone calls.
Calculate the average number of minutes a person spends on one phone call

No. of minutes	2	3	4	5	6
Frequency	12	20	36	20	12

3

Physical Activity : A group of first-year preparatory students were asked about the number of hours they spend in sports each week , and the answers are shown in the opposite table.
Calculate the arithmetic mean of the number of hours these students spend in sports.

No. of hours	8	9	10	11	12
Frequency	6	8	14	8	4

4

If the masses of the school's Karate team players in kilograms are given in the following table :

Mass (kg)	Frequency
71	1
72	2
73	4
74	3
75	5
76	3
77	2



Calculate the arithmetic mean of the masses of these players

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- 5**  The following table shows the number of working hours for a group of workers :

No. of hours (x)	5	6	7	8	9	10
No. of workers (f)	12	n	30	39	16	9

Find the number of workers who work 6 hours such that the arithmetic mean of the number of working hours is 7.5

- 6**  The following table shows the number of children in each family for a group of families :

Find the number of families that have 4 children , such that the arithmetic mean of the number of children is 3.

No. of children	No. of families
0	20
1	40
2	60
3	80
4	m

- 7**  **Open-ended Problem :** Write down five numbers whose arithmetic mean is 11 , median is 12 , and mode is 14

- 8**  **Critical Thinking :** If the arithmetic mean of a set of five different positive integers is 13 , and the median is 17 , find the maximum value of the greatest integer in this set.

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Quiz

Choose the correct answer from the given ones :

- 1 If the median of eight consecutive odd numbers is 22, then what is the arithmetic mean of the largest two numbers ?

(a) 25 (b) 26
(c) 28 (d) 29

- 2 If the arithmetic mean of six consecutive even numbers is 35, then what is the smallest of these numbers ?

(a) 36 (b) 34
(c) 32 (d) 30

- 3 For a set of values :
If $\Sigma f = 10$ and $\Sigma (f \cdot X) = 40$,
then what is the value of $\bar{X}$?

(a) 4 (b) 30
(c) 50 (d) 400

- 4 If some data is organized in the following stem-and-leaf diagram, then what is the arithmetic mean of this data ?

	Stems	Leaves
(a) 22	1	0 2 9
(b) 23	2	4 5 5 6 7
(c) 24	3	4 8
(d) 25	Key	3 4 means 34

- 5 If the arithmetic mean of Magdy's marks in 4 tests is 16, then what mark should Magdy have in the fifth test to have average of 18 across all tests?

(a) 24 (b) 25
(c) 26 (d) 27

- 6 55, 75, 55, 42, and 47 represent the numbers of children who took the infantile paralysis vaccine over five days. If the number of children who took the vaccine on the sixth day is 95, then which of the following statements is true ?
- (a) The median decreases
(b) The mode increases
(c) The average decreases
(d) The average increases

- 7 For a set of values :
If $\bar{X} = 20$ and $\Sigma (f \cdot X) = 1,500$
What is the value of Σf ?

(a) 75 (b) 150
(c) 3,000 (d) 30,000

- 8 Four numbers, the average of the first two numbers is 25 and the average of the last two numbers is 34. What is the average of all four numbers?

(a) 27.5 (b) 28
(c) 29.5 (d) 30

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9 If the arithmetic mean of the numbers :

$X + 3$, $X - 4$, $2X + 5$, 6 , X is 8

What is the value of X ?

- (a) 3 (b) 4
(c) 5 (d) 6

10 The arithmetic mean of the marks of

6 students is 79. If the marks of two new students are added , and the mean increases to 82 , What is the mean of the two added students ?

- (a) 81 (b) 86
(c) 92 (d) 91

11 If the arithmetic mean of five integers

is 16, the median is 17, and the mode is 13 , What is the largest of these numbers ?

- (a) 18 (b) 19
(c) 28 (d) 29

12 In five mathematics tests , Sandy got

18 , 17 , 16 , 15 , and 18 marks.

If the teacher removes the lowest mark, which of the following is true ?

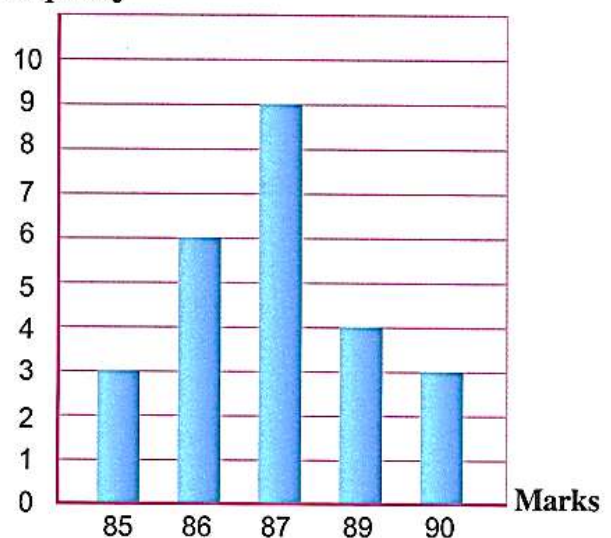
- (a) The average decreases
(b) The median decreases
(c) The average increases
(d) The median does not change

13 The following figure shows the marks of

25 students. What is the arithmetic mean of these marks ?

- (a) 86
(b) 87
(c) 87.2
(d) 87.5

Frequency



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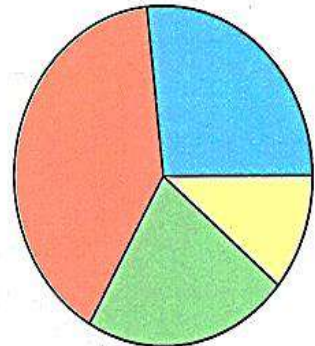
Lesson 3

Pie Charts

Pie Charts

A pie chart is a circle divided into sectors based on the percentage of frequencies in each group of the distribution. It is a simplified graphical method to show parts-to-whole relationship and visually comparing the areas of the sectors.

Note that : The sum of the percentages of circular sectors = 100 %



Example ①

The following table shows the contributions of four persons (in thousand LE) in one of the projects :

Name	Ibrahim	Mahmoud	Islam	Wael
Amount	10	11	6	9

Represent the share of each person in the project using a pie charts.

Solution

- The total amount = $10 + 11 + 6 + 9 = 36$ thousand LE.
- Find the measure of the central angle of each sector :

Measure of the central angle

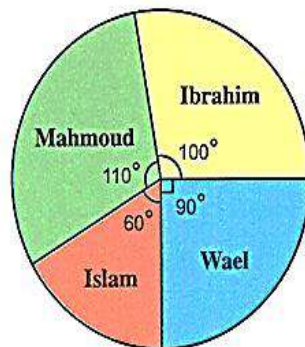
$$= \frac{\text{amount of each person}}{\text{Total amount}} \times 360^\circ$$

«Ibrahim» $\frac{10}{36} \times 360^\circ = 100^\circ$

«Mahmoud» $\frac{11}{36} \times 360^\circ = 110^\circ$

«Islam» $\frac{6}{36} \times 360^\circ = 60^\circ$

«Wael» $\frac{9}{36} \times 360^\circ = 90^\circ$



Steps for Drawing

- Draw an appropriate circle and draw its radius.
- Use a protractor to draw a central angle of measure 100° ; this sector represents "Ibrahim".
- Similarly , draw a central angle of measure 110° to represent "Mahmoud".
- Also , draw a central angle of measure 60° to represent "Islam".
- The remaining part is the sector that represents "Wael".

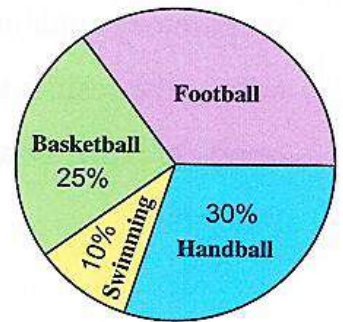
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Ex.1) Complete the following:

1 The sum of the measure of the accumulative angles around the center of a circle =°

2 The measure of the central angle of the sector whose area is $\frac{1}{4}$ of the area of the circle =°

3 The opposite pie chart represents the distribution of sports activities for students in a school. If the number of students in the school is 1,200 students , then



First : The percentage of students participating in football =

Second : The measure of the central angle of the sector representing the students participating in handball =

Third : The number of students participating in swimming =

Ex.2) Answer the following :

1 **Sports** : In a tennis match , a player hit 15 smashes , distributed as shown in the table opposite. Draw a pie chart for this distribution.

Set	First	Second	Third
No. of hits	7	3	5

2 **Elections** : The opposite table represents the number of votes each of Khaled , Anas , and Hamza gained in the classroom election. Use a pie chart to represent this data.

Student Name	Number of votes
Khaled	8
Anas	12
Hamza	10

3 **Survey** : In a survey of a group of first-year preparatory students about their favorite color , the results were recorded in the opposite table. Draw a pie chart to represent this table

Favorite color	Percentage
Red	25 %
Blue	30 %
Green	10 %
Yellow	35 %

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4

Sports : In a survey of a group of people were asked their favorite sport , the results were as follows :

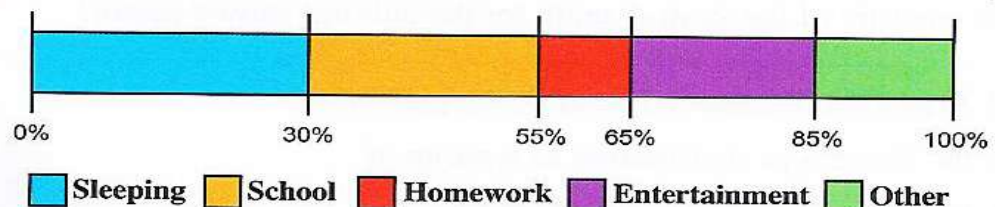


Sports	Handball	Basketball	football	Volleyball
Percentage	15 %	25 %	45 %	

Represent the survey results using a pie chart.

5

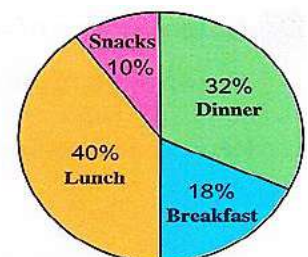
Daily Life : The figure below illustrates how Bassem spends his entire day :



Draw a pie chart expressing this routine.

6

Nutrition : The opposite pie chart shows the percentage of calories Sally had in her meals on one day. If Sally had 2,500 calories that day , how many calories did she have at dinner ?



Find the measure of the central angle for the breakfast sector.

7

The opposite graph represents the broad casting of a T.V channel for 10 hours on one day

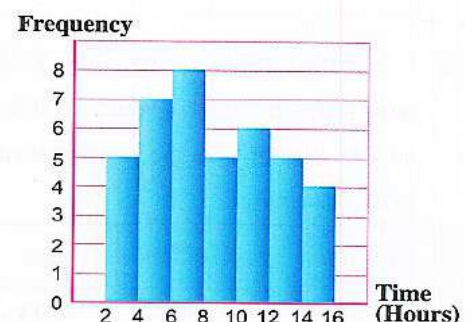
- Calculate the percentage of the broadcasting hours for entertainment shows.
- Find the measure of the central angle for the cultural shows' sector.



8

The opposite histogram shows the time that 40 students spend using their smartphones each week.

Represent this data using a pie chart.



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Quiz

Choose the correct answer from the given ones :

1. In a survey of 2,000 girls about their preferred hobby , as shown in the opposite pie chart.

First : Which is the most preferred hobby ?

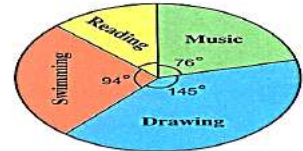
- (a) Drawing (b) Music
(c) Swimming (d) Reading

Second: What is the measure of the central angle corresponding to the reading sector ?

- (a) 35° (b) 45° (c) 86° (d) 104°

Third : Which hobby do approximately $\frac{1}{4}$ of the girls prefer ?

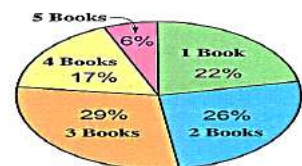
- (a) Drawing (b) Music (c) Swimming (d) Reading



2. The opposite pie chart shows the number of books read by 300 students in a school.

How many students read fewer than 4 books ?

- (a) 51 (b) 77
(c) 231 (d) 282



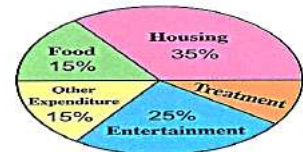
3. When representing the following table using a pie chart , what is the measure of the central angle corresponding to the coffee sector ?

Drink	Coffee	Tea	Juices
People	150	350	100

- (a) 45° (b) 90°
(c) 120° (d) 150°

4. The following diagram represents the pie chart of a family's monthly expenses with a monthly income of 12,000 L.E. How much are the monthly expenses for treatment ?

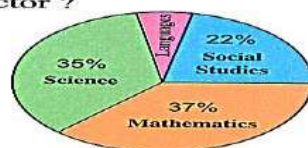
- (a) 120
(b) 1,200
(c) 2,400
(d) 3,000



5. The following pie chart represents the results of a survey on a favorite subjects among a group of students , where 700 students preferred science.

First : What is the percentage of the languages sector ?

- (a) 6 %
(b) 8 %
(c) 9 %
(d) 12 %



Second : How many students were surveyed ?

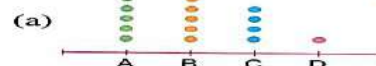
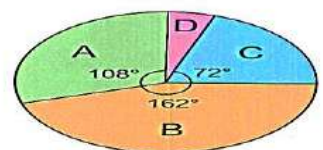
- (a) 210 (b) 700
(c) 1,400 (d) 2,000

Third : How many students preferred studying languages ?

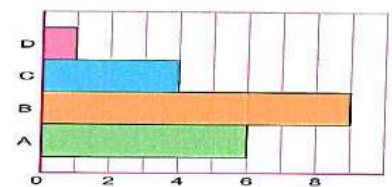
- (a) 120 (b) 240
(c) 320 (d) 480

6. **Creative Thinking :**

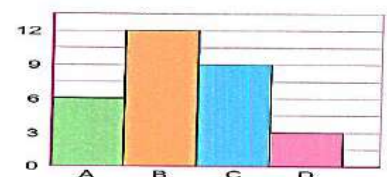
Which of the following distributions is represented by the opposite pie chart ?



(b)



(c)



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Lesson 1

Types of Angles and Relationships betw. them

Unit 4

Concept of an Angle

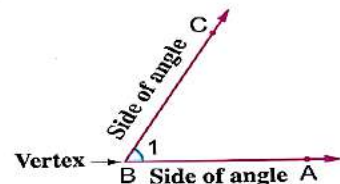
An angle is a union of two rays with a common starting point.

- The common starting point of the two rays known as the vertex of the angle.
- Each ray is called a side of the angle.

For example : In the opposite figure

$$\overrightarrow{BA} \cup \overrightarrow{BC} = \angle ABC$$

And it is called : $\angle ABC$ or $\angle CBA$ or $\angle B$ or $\angle 1$



Angle Measure

- A protractor is used to measure an angle , and the angles are measured in degrees.

For example : The measure of $\angle ABC$ in the opposite figure is 50° and it is written as follows : $m(\angle ABC) = 50^\circ$



- Degrees are divided into smaller parts : minutes (') and seconds (")

– One degree equals 60 minutes ($1^\circ = 60'$) – One minute equals 60 seconds ($1' = 60''$)

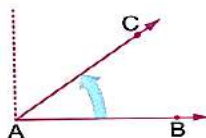
Types of Angles according to their Measurement

1 Zero Angle



An angle measures 0° where the sides coincide with each other

2 Acute Angle



An angle measures more than 0° but less than 90°

3 Right Angle



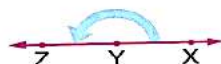
An angle measures exactly 90°

4 Obtuse Angle



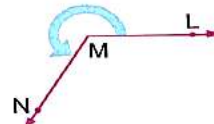
An angle measures more than 90° but less than 180°

5 Straight Angle



An angle measures exactly 180° , its sides forming a straight line and in opposite directions

6 Reflex Angle



An angle measures more than 180° but less than 360°



Note

A full circle measures 360° , so the sum of the measures of angle $\angle M$ and reflex $\angle M$ equals 360°

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Relation between Angles

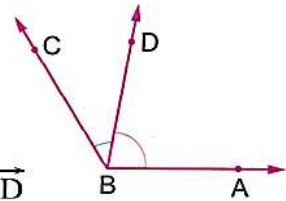
Adjacent Angles

Adjacent angles are two angles in the same plane, with a common vertex and a common side and the other two sides lying on opposite sides of the common side.

For example : In the opposite figure :

Angles $\angle ABD$ and $\angle CBD$ are adjacent because :

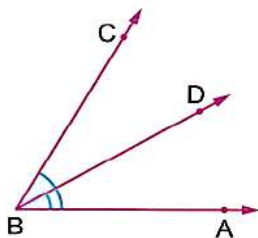
- They share : The vertex B and The side $\overrightarrow{BD}$
- The other sides $\overrightarrow{BA}$ and $\overrightarrow{BC}$ lie on opposite sides of the common side $\overrightarrow{BD}$



Notes

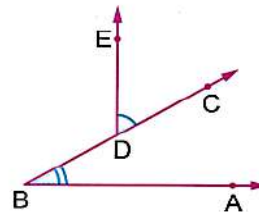
1 In the following figure :

$\angle ABD$ and $\angle ABC$ are not adjacent because sides $\overrightarrow{BD}$ and $\overrightarrow{BC}$ lie on the same side of the common side $\overrightarrow{BA}$



2 In the following figure :

$\angle ABC$ and $\angle CDE$ are not adjacent because they do not share a common vertex or side.



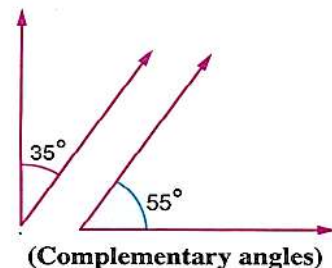
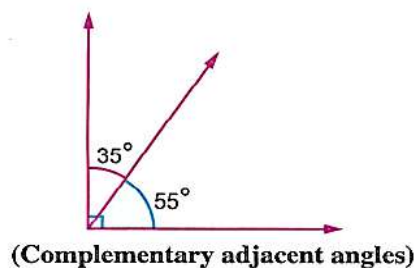
Complementary Angles

Complementary angles are two angles whose measures have a sum of 90°

For example :

Two angles measuring 55° and 35° are complementary angles

Because : $55^\circ + 35^\circ = 90^\circ$



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Notes

- 1 Complementary angles can either be : two acute angles or one of them is zero and the other is right.
- 2 Complements of the same angle (or angles with equal measure) are equal in measure.
So , if $\angle A$ complements $\angle B$ and $\angle C$ complements $\angle B$ therefore :
 $m(\angle A) = m(\angle C)$

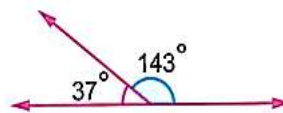
Supplementary Angles

Supplementary angles are two angles whose measures have a sum of 180°

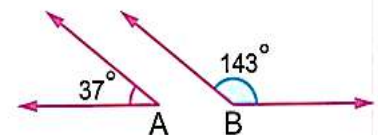
For example :

Two angles measuring 143° and 37°
are supplementary angles

Because : $143^\circ + 37^\circ = 180^\circ$



(Supplementary adjacent angles)



(Supplementary angles)



Notes

- 1 Supplementary angles can either be : one is obtuse and the other is acute , two right angles , or one is zero and the other is straight.
- 2 Supplements of the same angle (or angles with equal measure) are equal in measure.
So , if $\angle A$ supplements $\angle B$ and $\angle C$ supplements $\angle B$ therefore : $m(\angle A) = m(\angle C)$

Adjacent Supplementary Angles

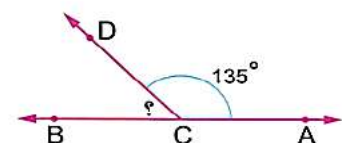
The two adjacent angles formed by the intersection of a straight line and a ray whose starting point lies on the straight line are supplementary

So that : In the opposite figure :

If $\overrightarrow{AB} \cap \overrightarrow{CD} = \{C\}$

So that : $m(\angle ACD) + m(\angle DCB) = 180^\circ$

If $m(\angle ACD) = 135^\circ$ So that : $m(\angle DCB) = 180^\circ - 135^\circ = 45^\circ$



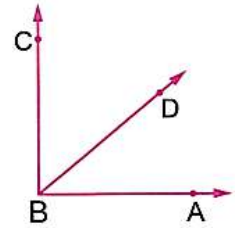
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Adjacent Complementary Angles

The two adjacent angles whose outer sides are perpendicular to each other are complementary.

If $\overrightarrow{BA} \perp \overrightarrow{BC}$

, then $m(\angle ABD) + m(\angle DBC) = 90^\circ$



The outer Sides of Adjacent Angles

If the adjacent angles are supplementary

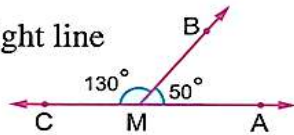
1, then their outer sides lie on a straight line.

For example : in the opposite figure :

$\overrightarrow{MA}$ and $\overrightarrow{MC}$ On a straight line

because :

$$\begin{aligned} m(\angle AMB) + m(\angle BMC) \\ = 50^\circ + 130^\circ = 180^\circ \end{aligned}$$



If the adjacent angles are complementary

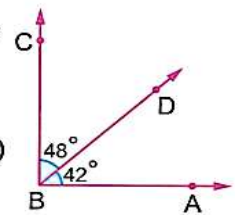
2, then their outer sides are perpendicular to each other.

For example : in the opposite figure :

$\overrightarrow{BA}$ and $\overrightarrow{BC}$ are perpendicular

because :

$$\begin{aligned} m(\angle ABD) + m(\angle DBC) \\ = 42^\circ + 48^\circ = 90^\circ \end{aligned}$$



Note that

The bisector of an angle is the ray that divides the angle into two congruent angles (equal in measure).

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 An angle is
- 2 The bisector of an angle is
- 3 Complementary angles are two angles whose measures have a sum of°
- 4 Supplementary angles are two angles whose measures have a sum of°
- 5 The two adjacent angles formed by the intersection of a straight line and a ray whose starting point lies on the straight line are
- 6 The two adjacent angles whose outer sides are perpendicular are
- 7 The two adjacent angles whose outer sides lie on a straight line are
- 8 If the adjacent angles are supplementary, their outer sides are
- 9 If $m(\angle A) = 50^\circ$, then $m(\text{reflex} \angle A) = \dots\dots\dots^\circ$
- 10 If $m(\text{reflex} \angle X) = 237^\circ$, then $m(\angle X) = \dots\dots\dots^\circ$
- 11 The measure of the angle equivalent to the sum of two right angles is =° and is called a angle.
- 12 The angle that measures 50° complements an angle that measures° and supplements an angle that measures°
- 13 The angle that measures° complements an angle that measures 30° and supplements an angle that measures°
- 14 The angle that measures° complements an angle that measures° and supplements an angle that measures 150°
- 15 An acute angle is complemented by an angle that is and supplemented by an angle that is
- 16 A zero angle is complemented by an angle that is and supplemented by an angle that is
- 17 A right angle is complemented by an angle that is and supplemented by an angle that is
- 18 An obtuse angle supplements an angle that is

SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

1

State the types of each angle , if their measures are :

- ① 57° ② 117° ③ 180° ④ $89^\circ 60'$ ⑤ $179^\circ 62'$

2

Write the measure of the angle that complements each of the following angles :

- ① 60° ② 45° ③ $22\frac{1}{2}^\circ$ ④ $25^\circ 60'$ ⑤ 0°

3

Write the measure of the angle that supplements each of the following angles :

- ① 10° ② 117° ③ $92\frac{1}{2}^\circ$ ④ 180° ⑤ $141^\circ 60'$

4

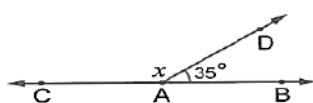
Complete each of the following :

- ① If $m(\angle A) = 30^\circ$ and $\angle A$ complements $\angle B$, then $m(\text{reflex } \angle B) = \dots\dots\dots^\circ$
 ② Complementary angles that are equal in measure have a measure of $\dots\dots\dots^\circ$
 ③ If $\angle A$ and $\angle B$ are supplementary angles and $m(\angle A) = 2m(\angle B)$,
 then $m(\angle B) = \dots\dots\dots^\circ$
 ④ If $m(\angle X) = \frac{1}{2}m(\angle Y)$ and $m(\angle X) = 30^\circ$, then angles X and Y are $\dots\dots\dots$
 ⑤ If $\angle A$ complements $\angle B$ and $m(\angle A) = \frac{2}{3}m(\angle B)$, then $m(\angle B) = \dots\dots\dots^\circ$
 ⑥ If the ratio between the measures of two supplementary angles is $7 : 2$, then the
 measure of the larger angle is $\dots\dots\dots^\circ$
 ⑦ If $\angle A$ complements $\angle B$, $\angle B$ supplements $\angle C$ and $m(\angle A) = 32^\circ$,
 then $m(\angle C) = \dots\dots\dots^\circ$

5

In each of the following figure , find the required below :

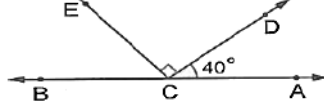
① 



If $A \in \overleftrightarrow{BC}$

Find : x

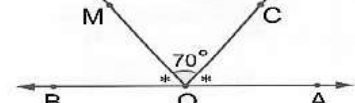
② 



If $C \in \overleftrightarrow{AB}$

Find : $m(\angle ECB)$

③ 



If $O \in \overleftrightarrow{AB}$

Find : $m(\angle AOM)$

6

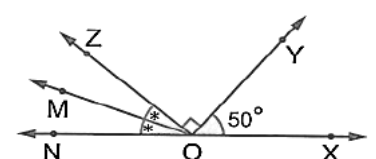
 Two complementary angles , the ratio between their measures is $5 : 7$.
 Find the measure of the smaller angle.

7

 In the opposite figure :

$O \in \overleftrightarrow{XN}$ and $\overrightarrow{OM}$ bisect $\angle NOZ$

Find : $m(\angle MOX)$



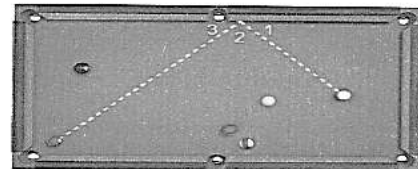
SIMPLEST MATHS BOOKLETS

8

Sports :

In the opposite billiard table , if the measure of $\angle 1$ equals the measure of $\angle 3$,
and the measure of $\angle 1$ is 43°

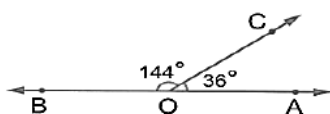
Calculate : Measure of $\angle 2$



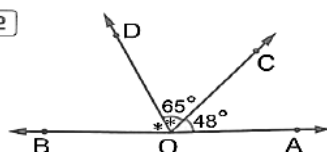
9

In each of the figures below , do $\overrightarrow{OA}$ and $\overrightarrow{OB}$ form a straight line or not ? Why ?

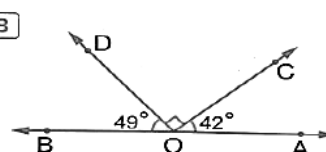
1



2



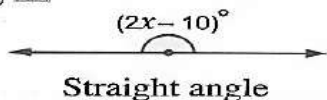
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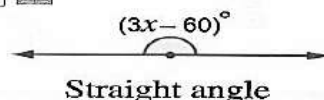
10

In each of the following , find the value of x :

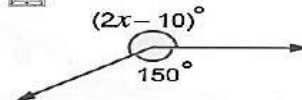
1



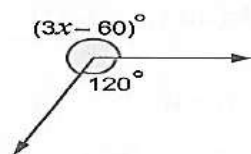
2



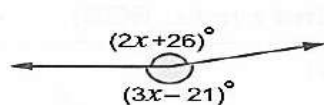
3



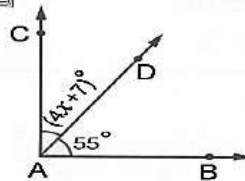
4



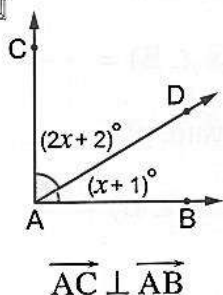
5



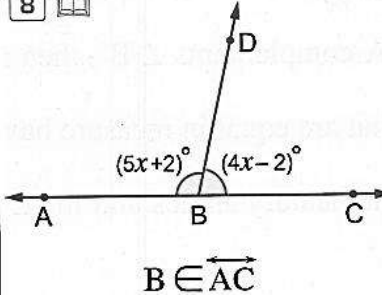
6



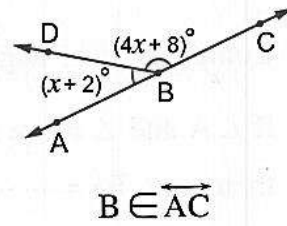
7



8



9



SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

1 What is the type of the angle that supplements an acute angle ?

- (a) Acute (b) Obtuse
(c) Straight (d) Reflex

2 What is the type of the angle that complements a right angle ?

- (a) Acute (b) Obtuse
(c) zero (d) Reflex

3 If the two angles A and B are complementary and $m(\angle A) = 40^\circ$, what is the measure of angle $\angle B$?

- (a) 40° (b) 50° (c) 90° (d) 140°

4 What is the measure of the angle that supplements an angle of measure $34^\circ 60'$?

- (a) 55° (b) 56°
(c) 145° (d) 146°

5 If $\overrightarrow{BA} \perp \overrightarrow{BC}$, then what is the measure of angle $\angle ABC$?

- (a) 40° (b) 90°
(c) 180° (d) 360°

6 If $\angle A$ supplements $\angle B$ and $\angle A$ supplements $\angle C$, then $\angle B$ and $\angle C$ are

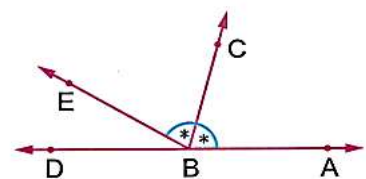
- (a) equal in measure. (b) complementary.
(c) supplementary. (d) adjacent.

7 If $m(\angle A) = m(\angle B)$ and $\angle A$ supplements $\angle B$, then what is the measure of $\angle B$?

- (a) 30°
(b) 45°
(c) 60°
(d) 90°

8 If $B \in \overrightarrow{AD}$, $\overrightarrow{BC}$ bisects $\angle ABE$ and $m(\angle EBA) = 150^\circ$, what is the measure of angle $\angle DBC$?

- (a) 150°
(b) 105°
(c) 75°
(d) 30°



9 The bisectors of two adjacent supplementary angles are.....

- (a) perpendicular.
(b) parallel.
(c) coinciding.
(d) forming an acute angle.

10 $m(\angle A) + m(\text{reflex } \angle A)$ equals the measure of

- (a) right angle.
(b) 2 right angles.
(c) 3 right angles.
(d) 4 right angles.

SIMPLEST MATHS BOOKLETS

Lesson 2

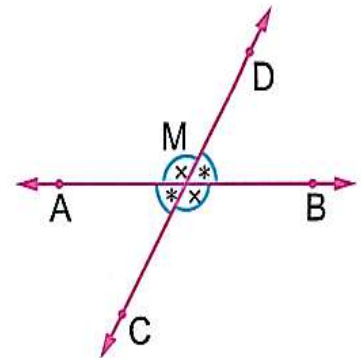
Continue to Angle Relationships

The Vertically Opposite Angles

The vertically opposite angles are two non-adjacent angles formed by the intersection of two straight lines

For example :

- Angles $\angle AMC$ and $\angle BMD$ are vertically opposite angles
- Angles $\angle AMD$ and $\angle BMC$ are vertically opposite angles



The two vertically opposite angles are congruent (equal in measure).

So that : $m(\angle AMD) = m(\angle BMC)$ and $m(\angle AMC) = m(\angle BMD)$

The Accumulative Angles at a Point

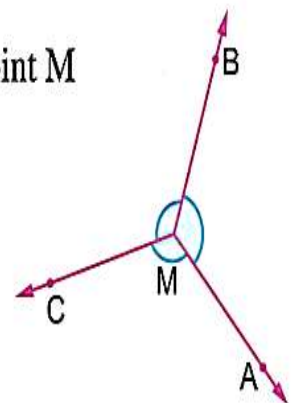
The sum of the measures of accumulative angles at a point is equal to 360°

For example : If $\overrightarrow{MA}$, $\overrightarrow{MB}$ and $\overrightarrow{MC}$ are rays have the same starting point M

$\angle AMB$, $\angle BMC$ and $\angle CMA$ are called

accumulative angles at point M and :

$$m(\angle AMB) + m(\angle BMC) + m(\angle CMA) = 360^\circ$$



SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

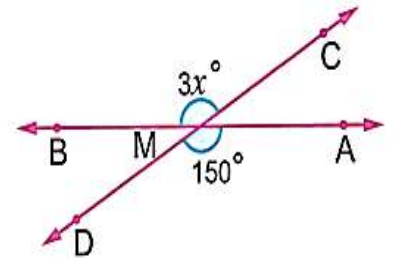
1 If two straight lines intersect , then each two vertically opposite angles are

2 The sum of the measures of the accumulative angles at a point equals

3 In the opposite figure :

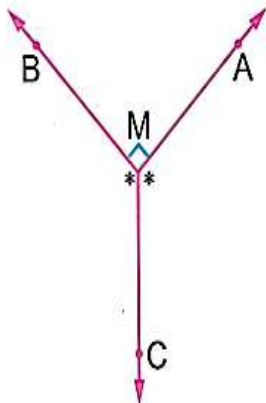
$$\text{If } \overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{M\}$$

, then : $x = \dots\dots\dots^\circ$



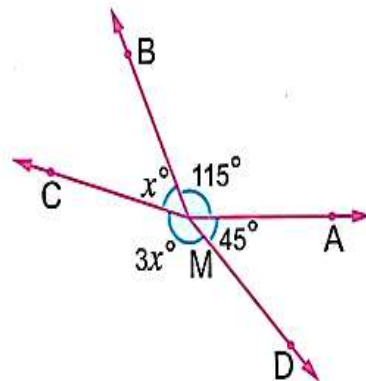
4 In the below figure :

$$m(\angle AMC) = \dots\dots\dots^\circ$$



5 In the below figure :

$$x = \dots\dots\dots^\circ$$

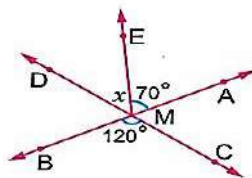


SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

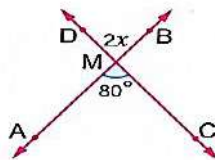
1

1 $\overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{M\}$



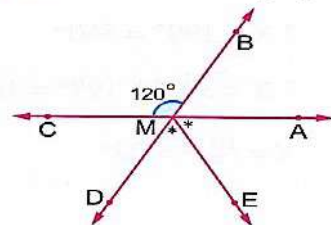
Find the value of x

2 $\overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{M\}$



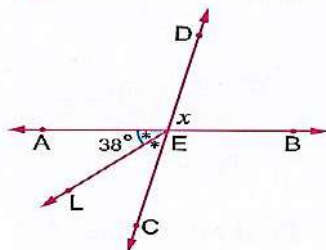
Find the value of x

3 $\overleftrightarrow{AC} \cap \overleftrightarrow{BD} = \{M\}$



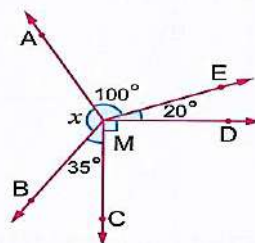
Find $m(\angle EMD)$

4 $\overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{E\}$



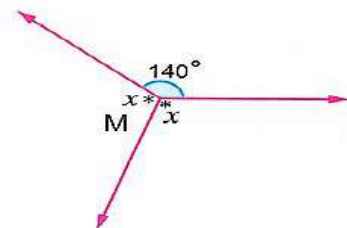
Find the value of x

5



Find the value of x

6



Find the value of x

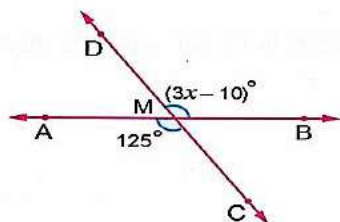
2

Two vertically opposite angles : The measure of one of them is $(2x)^\circ$ and the measure of the other is $(x + 28)^\circ$
Find the measure of one of them.

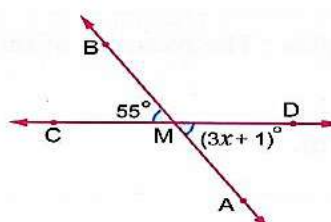
3

Find the value of x in each of the following :

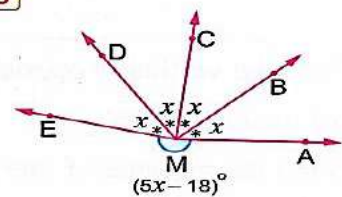
1 $\overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{M\}$



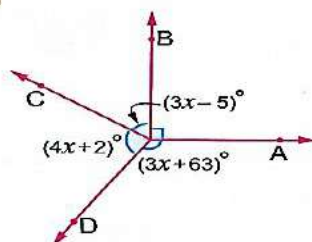
2 $\overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{M\}$



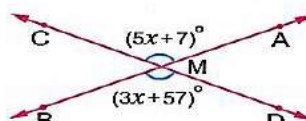
3



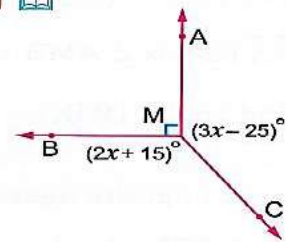
4



5 $\overleftrightarrow{AB} \cap \overleftrightarrow{CD} = \{M\}$



6



SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

1 The angle with a measure of 60° has a vertically opposite angle with a measure of

- (a) 30° (b) 60° (c) 90° (d) 180°

2 The sum of the measures of angles around a point equals the measure of

- (a) 2 right angles. (b) 3 right angles.
(c) 4 right angles. (d) 5 right angles.

3 The sum of the measures of 4 angles around a point is the sum of the measures of 5 angles around a point.

- (a) = (b) < (c) > (d) $\neq$

4 If the vertically opposite angles are complementary , then the measure of each is

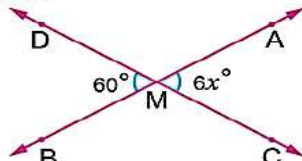
- (a) 180° (b) 90° (c) 50° (d) 45°

5 In the opposite figure :

$$\overrightarrow{AB} \cap \overrightarrow{DC} = \{M\}$$

What is the value of x ?

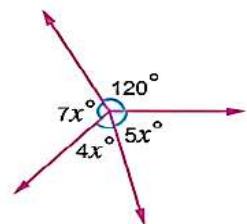
- (a) 6° (b) 60°
(c) 10° (d) 30°



6 In the opposite figure :

What is the value of x ?

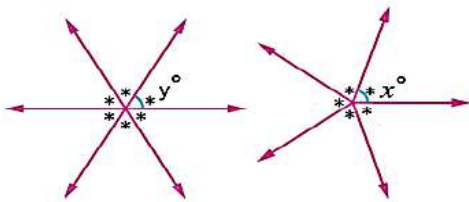
- (a) 5° (b) 15°
(c) 60° (d) 240°



7 In the opposite figure :

$$x + y = \dots\dots\dots$$

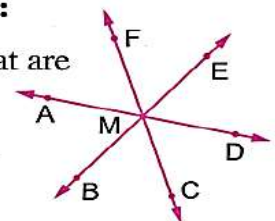
- (a) 72°
(b) 120°
(c) 132°
(d) 144°



8 In the opposite figure :

The number of pairs that are vertically opposite angles equals

- (a) 2 (b) 3
(c) 4 (d) 6



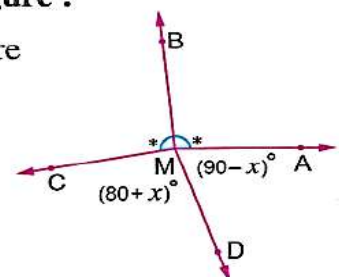
9 If the ratio among the measures of 3 angles around a point is $4 : 3 : 2$, then the measure of the greatest angle is

- (a) 40° (b) 80°
(c) 120° (d) 160°

10 In the opposite figure :

What is the measure of $\angle AMB$?

- (a) 190° (b) 95°
(c) 90° (d) 80°



SIMPLEST MATHS BOOKLETS

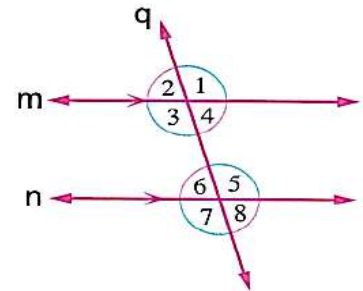
Lesson 3

Parallelism

The Relation Between Pairs of Angles Formed When a Straight Line Intersects Two Parallel Straight Lines

- When a straight line intersects two parallel straight lines, any pair of angles formed by the intersection are either equal in measure or supplementary.

For example : If $m \parallel n$ and the straight line q is a transversal, then :



1 Each two corresponding angles are equal in measure.

- $m(\angle 2) = m(\angle 6)$
- $m(\angle 1) = m(\angle 5)$
- $m(\angle 3) = m(\angle 7)$
- $m(\angle 4) = m(\angle 8)$

2 Each two alternating interior angles are equal in measure.

- $m(\angle 3) = m(\angle 5)$
- $m(\angle 4) = m(\angle 6)$

3 Each two alternating exterior angles are equal in measure.

- $m(\angle 2) = m(\angle 8)$
- $m(\angle 1) = m(\angle 7)$

4 Each two interior angles on the same side of the transversal are supplementary.

- $m(\angle 4) + m(\angle 5) = 180^\circ$
- $m(\angle 3) + m(\angle 6) = 180^\circ$

How to Prove That Two Straight Lines are Parallel

Two straight lines are parallel if a transversal intersects them and one of the following conditions has occurred :

- Two corresponding angles are equal in measure.
- Two alternating angles (both interior or both exterior) are equal in measure.
- Two interior angles on the same side of the transversal are supplementary.

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 If a straight line perpendicular to one of two parallel straight lines then it is the other in the plane.
- 2 If two straight lines are parallel to a third straight line , then they are
- 3 If two straight lines perpendicular to a third line in the plane , then these lines are
- 4 If a straight line intersects two parallel lines , then any two alternating angles are
- 5 If a straight line intersects two parallel straight lines , then any two corresponding angles are
- 6 If a straight line intersects two parallel straight lines , then any two interior angles on the same side of the transversal are
- 7 If a straight line intersects two straight lines and produces two corresponding angles that are equal in measure , then the straight lines are
- 8 If a straight line intersects two straight lines and produces two alternating angles that are equal in measure , then the two straight lines are
- 9 If a straight line intersects two straight lines and the interior angles on the same side of the transversal are supplementary , then the two straight lines are

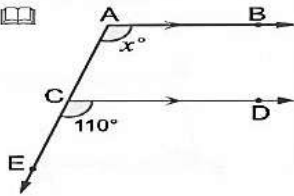
SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

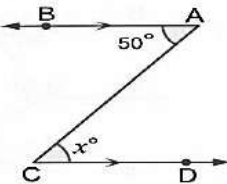
1

Find the value of x in each of the following figures :

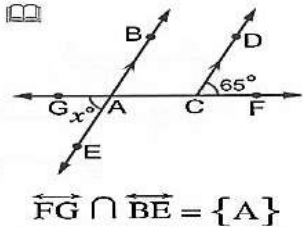
1



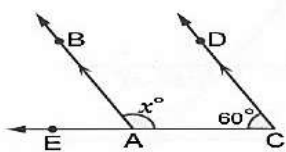
2



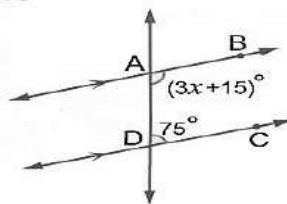
3



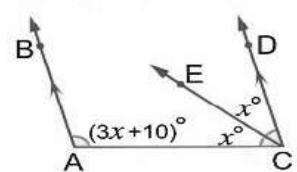
4



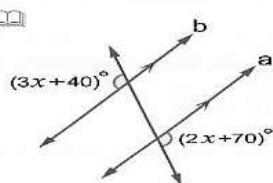
5



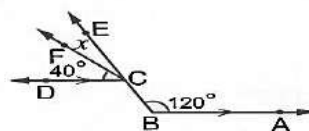
6



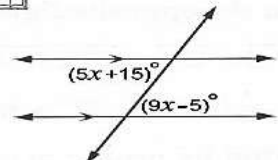
7



8



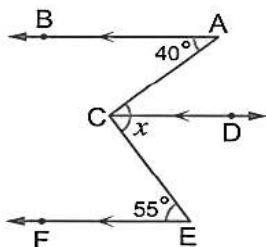
9



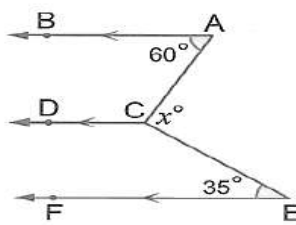
2

Find the value of x in each of the following figures :

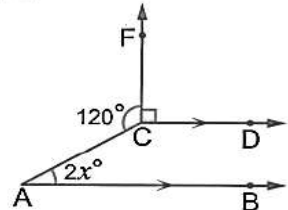
1



2



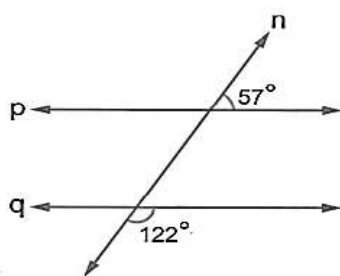
3



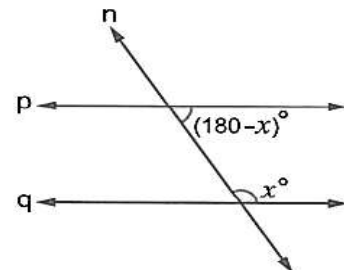
3

In each of the following : is $p \parallel q$? why ?

1



2



SIMPLEST MATHS BOOKLETS

4

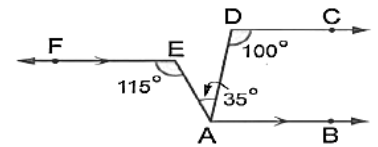
 In the opposite figure :

$$\overrightarrow{AB} \parallel \overrightarrow{EF}$$

$$, m(\angle D) = 100^\circ , m(\angle E) = 115^\circ$$

$$, m(\angle DAE) = 35^\circ$$

Prove that : $\overrightarrow{AB} \parallel \overrightarrow{DC}$

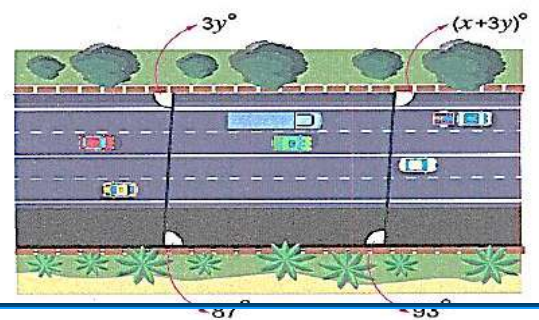


5

 **Road Safety :**

The opposite figure shows
a pedestrian road next to a car road.

What is the value of x ?

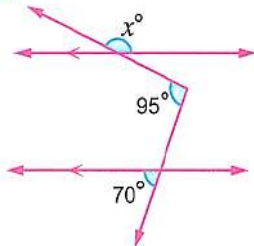


6

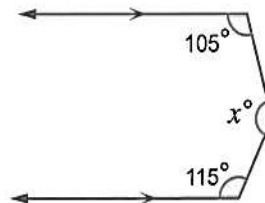


Find the value of x in each of the following figures :

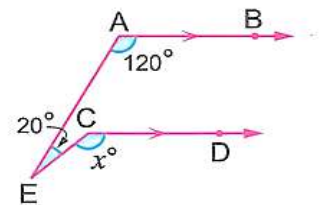
1



2



3



SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

- 1 If L_1 , L_2 and L_3 are three lines in the same plan, $L_3 \parallel L_1$ and $L_3 \parallel L_2$ then :.....

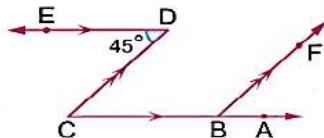
(a) $L_2 \perp L_1$ (b) $L_3 \perp L_1$
(c) $L_2 \parallel L_1$ (d) $L_3 \perp L_2$

- 2 If L_1 , L_2 and L_3 are three lines in the same plan, $L_2 \perp L_1$ and $L_3 \parallel L_1$ then : L_2 L_3

(a) $\perp$ (b) $\parallel$
(c) coincide (d) bisects

- 3 In the opposite figure :

$m(\angle D) = 45^\circ$
 $\overrightarrow{DE} \parallel \overrightarrow{CA}$
 $\overrightarrow{CD} \parallel \overrightarrow{BF}$

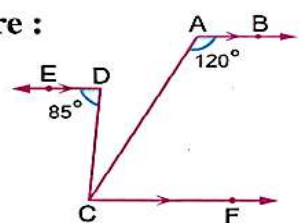


What is the measure of $\angle ABF$?

(a) 45° (b) 90°
(c) 135° (d) 40°

- 4 In the opposite figure :

$\overrightarrow{AB} \parallel \overrightarrow{CF} \parallel \overrightarrow{DE}$
 $m(\angle A) = 120^\circ$
 $m(\angle D) = 85^\circ$

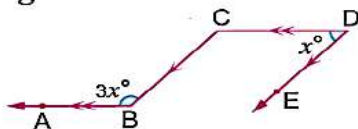


What is the measure of $\angle ACD$?

(a) 60° (b) 85°
(c) 25° (d) 120°

- 5 In the opposite figure :

$\overrightarrow{CD} \parallel \overrightarrow{BA}$
 $\overrightarrow{DE} \parallel \overrightarrow{CB}$

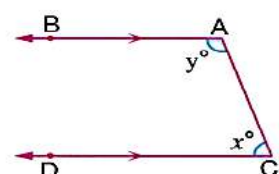


What is the value of x ?

(a) 60° (b) 45°
(c) 120° (d) 90°

- 6 In the opposite figure :

$\overrightarrow{AB} \parallel \overrightarrow{CD}$
 $\frac{x}{y} = \frac{7}{11}$

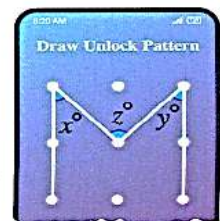


What is the value of x ?

(a) 60° (b) 70°
(c) 100° (d) 110°

- 7 **Critical Thinking** : Mostafa created a pattern to unlock his smartphone , as shown in the opposite figure. What is the relationship between x , y and z ?

(a) $x = y + z$ (b) $y = x + z$
(c) $z = x + y$ (d) $x + y + z = 360^\circ$



SIMPLEST MATHS BOOKLETS

Lesson 4

The Triangle

Sum of measures of Interior Angles of a Triangle

Rule :

Sum of the measures of the interior angles of any triangle is 180°

The straight lines m and n are parallel, straight line k intersects them at points A and B and straight line p intersects them at A and C

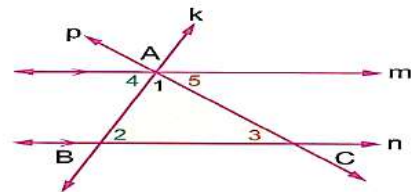
$\therefore \angle 4, \angle 1$ and $\angle 5$ form a straight angle

$$\therefore m(\angle 4) + m(\angle 1) + m(\angle 5) = 180^\circ$$

$\therefore m(\angle 4) = m(\angle 2)$ (alternating interior angles)

$\therefore m(\angle 5) = m(\angle 3)$ (alternating interior angles)

$$\therefore m(\angle 2) + m(\angle 1) + m(\angle 3) = 180^\circ$$

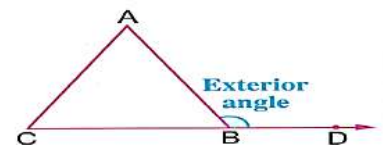


The Exterior Angle of a Triangle

In the opposite figure :

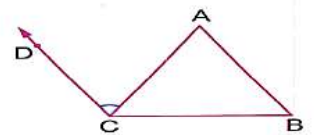
If ABC is a triangle, $D \in \overrightarrow{CB}$, $D \notin \overline{CB}$

then $\angle ABD$ is called an exterior angle of the triangle ABC



Note that

$\angle ACD$ is not an exterior angle of triangle ABC
because : $D \notin \overrightarrow{BC}$



Rule :

The measure of the exterior angle of any triangle is equal to the sum of the measures of the two non-adjacent interior angles

In the opposite figure :

If ABC is a triangle, $D \in \overrightarrow{CB}$, $D \notin \overline{CB}$, then $m(\angle ABD) = m(\angle A) + m(\angle C)$

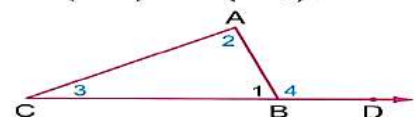
This can be proved as follows :

$$\therefore m(\angle 1) + m(\angle 2) + m(\angle 3) = 180^\circ \quad (1)$$

, $\therefore \angle 1$ and $\angle 4$ form a straight angle.

$$\therefore m(\angle 1) + m(\angle 4) = 180^\circ \quad (2)$$

From (1), (2) : $m(\angle 4) = m(\angle 2) + m(\angle 3)$



Triangle Inequality

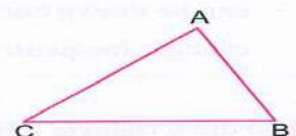
The sum of the lengths of any two sides of a triangle is greater than the length of the third side.

For example : In triangle ABC :

$$AB + BC > AC$$

$$AB + AC > BC$$

$$AC + BC > AB$$



The triangle inequality can be proved by doing the following activity :

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 The sum of the measures of the interior angles of a triangle =°
- 2 The measure of the exterior angle of any triangle equals the sum of
- 3 In triangle ABC , if $m(\angle A) = 70^\circ$ and $m(\angle C) = 50^\circ$, then $m(\angle B) = \dots\dots\dots^\circ$
- 4 The measure of each interior angle of a triangle can be equal to
- 5 If the measures of the three angles in a triangle are equal , then the measure of each angle is°



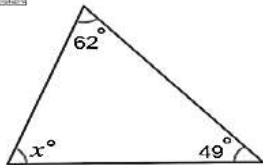
SIMPLEST MATHS BOOKLETS

Ex.2) Answer the following :

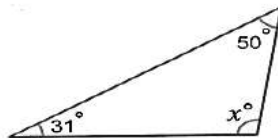
1

Find the value of the variable in each of the following :

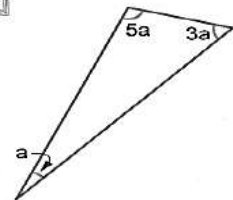
1



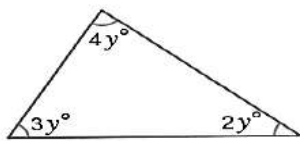
2



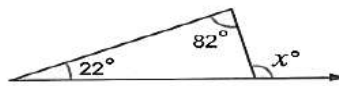
3



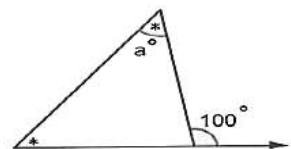
4



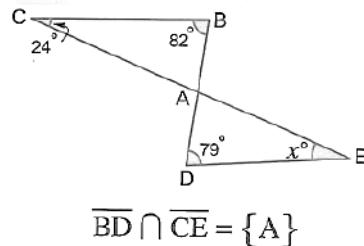
5



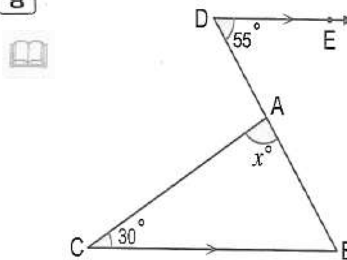
6



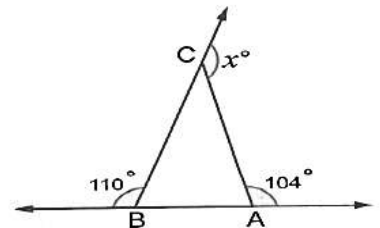
7



8



9



2

Which of the following sets of side lengths can be used to form a triangle ? Why ?

1 9 cm , 5 cm , 4 cm

2 7 cm , 6 cm , 5 cm

3 10 m , 5 m , 2 m

4 10 cm , 6 cm , 5 cm

5 8 cm , 4 cm , 4 cm

6 12 cm , 3 cm , 6 cm

3

If the lengths of two sides of a triangle are 5 cm and 2 cm , what is the largest integer that can represent the length of the third side ?

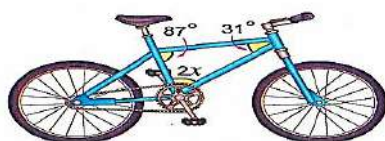
4

In triangle ABC , where the length of $\overline{AB}$ is 5 cm and the length of $\overline{BC}$ is 7 cm. What is the smallest possible integer value for the length of $\overline{AC}$?

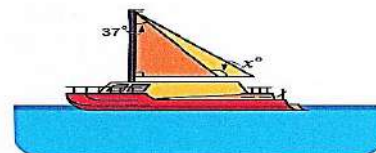
5

Calculate the value of x in each of the figures below :

1



2

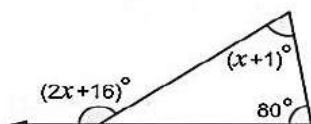


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6

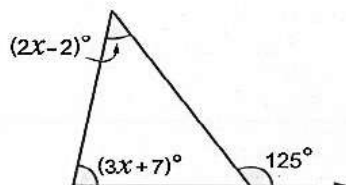
Find with proof the value of the required angles in each of the following figures :

1



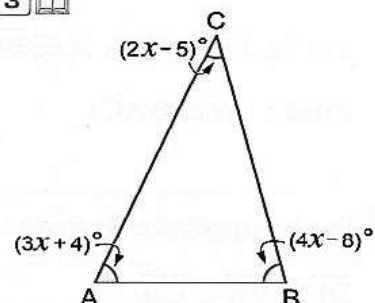
Find the value of x

2



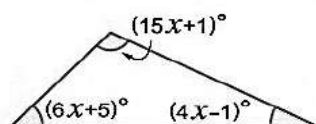
Find the value of x

3



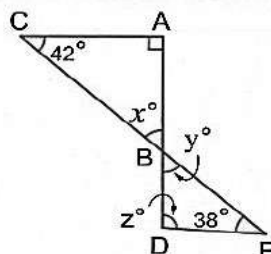
Find $m(\angle B)$

4



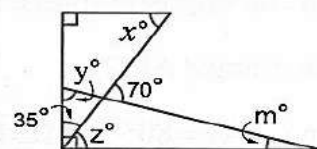
Find the value of x

5



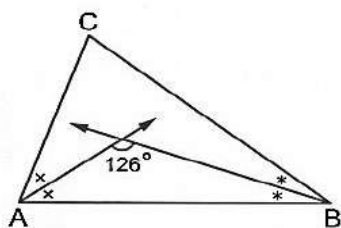
Find the values
of x, y, z

6



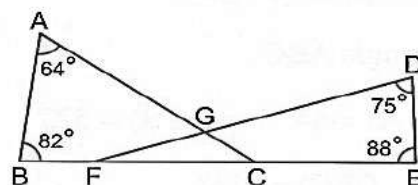
Find the values
of x, y, z, m

7



Find $m(\angle C)$

8



Find $m(\angle FGC)$

7

Critical Thinking : If ABC is a triangle in which the length of $\overline{BC}$ is 9 cm. Find the smallest integer for the perimeter of triangle ABC

SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

- | | |
|---|---|
| <p>1 If the sum of the measures of two angles in a triangle is 130°, then what is the measure of the third angle ?
(a) 20° (b) 30° (c) 50° (d) 60°</p> | <p>2 In triangle XYZ, if $m(\angle X) = 50^\circ$ and $m(\angle Y) = 100^\circ$, then what is the measure of $\angle Z$?
(a) 30° (b) 50° (c) 80° (d) 100°</p> |
| <p>3 In triangle ABC, if $m(\angle A) + m(\angle B) = 110^\circ$, then what is the measure of angle C ?
(a) 110° (b) 90° (c) 70° (d) 55°</p> | <p>4 The sum of the measures of the interior angles of a triangle equals the measure of
(a) a right angle. (b) a straight angle.
(c) an acute angle. (d) a reflex angle.</p> |
| <p>5 If the measures of two angles in a triangle are 30° and 70°, which of the following cannot be the measure of an exterior angle of the triangle ?
(a) 150° (b) 130° (c) 110° (d) 100°</p> | <p>6 The triangle consists of two angles at least
(a) acute (b) obtuse
(c) right (d) reflex</p> |
| <p>7 Which of the following sets of numbers cannot be used as side lengths of a triangle ?
(a) 4 cm, 7 cm, 7 cm
(b) 3 cm, 4 cm, 7 cm
(c) 7 cm, 7 cm, 7 cm
(d) 9 cm, 7 cm, 5 cm</p> | <p>8 The lengths of two sides of an isosceles triangle are 3 cm and 7 cm. What is the length of the third side ?
(a) 3 cm (b) 4 cm
(c) 5 cm (d) 7 cm</p> |
| <p>9 The sum of the lengths of any two sides in a triangle the length of the third side.
(a) smaller than (b) greater than
(c) equal (d) half</p> | <p>10 If ABC is a scalene triangle in which the length of $\overline{AC}$ is 3 cm, and the length of $\overline{BC}$ is 5 cm. How many integers could be the length of $\overline{AB}$?
(a) 2 (b) 3 (c) 4 (d) 5</p> |
| <p>11 In the triangle ABC, $\frac{AB + BC}{AC}$ 1
(a) < (b) > (c) = (d) $\geq$</p> | |

SIMPLEST MATHS BOOKLETS

Lesson 5

Quadrilaterals

The Sum of the measures of the Interior Angles of a Quadrilateral

The sum of the measures of the interior angles of any quadrilateral equals 360°

This rule can be verified by drawing one of the diagonals of the quadrilateral ABCD, such as $\overline{AC}$, So :

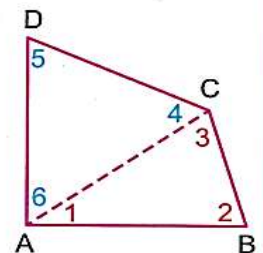
In the triangle ABC : $m(\angle 1) + m(\angle 2) + m(\angle 3) = 180^\circ$ (1)

, in the triangle ACD : $m(\angle 4) + m(\angle 5) + m(\angle 6) = 180^\circ$ (2)

By adding equations (1) and (2) :

$$[m(\angle 1) + m(\angle 6)] + m(\angle 2) + [m(\angle 3) + m(\angle 4)] + m(\angle 5) = 360^\circ$$

$$m(\angle A) + m(\angle B) + m(\angle C) + m(\angle D) = 360^\circ$$



Special Quadrilaterals

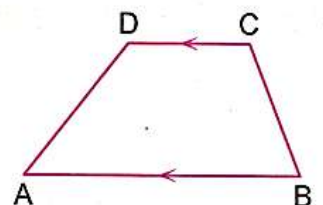
1 Trapezium

It is a quadrilateral that has only two parallel sides.

In the opposite figure :

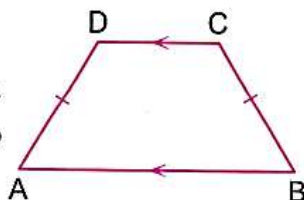
If $\overline{AB} \parallel \overline{DC}$, $\overline{DA}$ is not parallel to $\overline{CB}$

, then the quadrilateral ABCD is a trapezium.

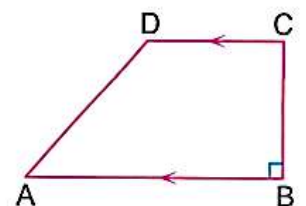


Notes

- ① If the non-parallel sides of a trapezium are equal in length, then it is called an isosceles trapezium.



- ② If one of the angles of a trapezium is a right angle, then it is called a right trapezium.



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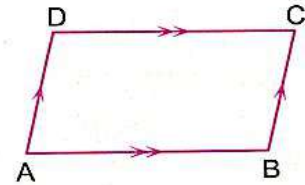
2 Parallelogram

A parallelogram is a quadrilateral in which each two opposite sides are parallel

In the opposite figure :

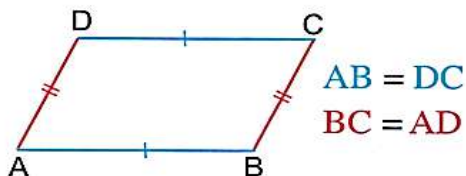
$$\overline{AB} \parallel \overline{DC}, \overline{AD} \parallel \overline{BC}$$

, then the quadrilateral ABCD is a parallelogram.

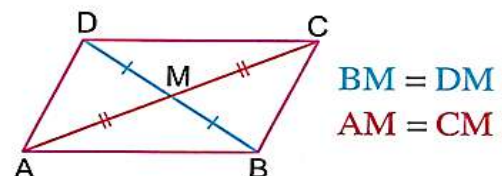


Properties of a Parallelogram

- 1 Each two opposite sides are equal in length.



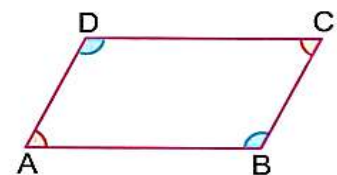
- 2 The diagonals bisect each other.



- 3 Each two opposite angles are equal in measure.

$$m(\angle A) = m(\angle C)$$

$$m(\angle B) = m(\angle D)$$



- 4 Each two consecutive angles are supplementary.

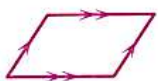
$$m(\angle A) + m(\angle B) = 180^\circ, \quad m(\angle B) + m(\angle C) = 180^\circ$$

$$m(\angle C) + m(\angle D) = 180^\circ, \quad m(\angle D) + m(\angle A) = 180^\circ$$

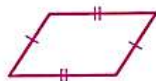
When does a quadrilateral become a parallelogram?

A quadrilateral is a parallelogram if any of the following conditions has occurred

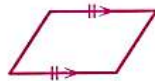
Each two opposite sides are parallel.



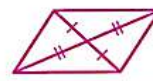
Each two opposite sides are equal in length.



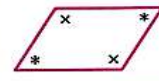
Two opposite sides are both parallel and equal in length.



Diagonals bisect each other.



Each two opposite angles are equal in measure.

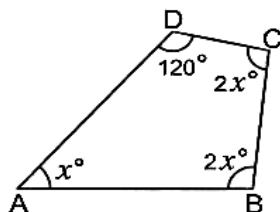


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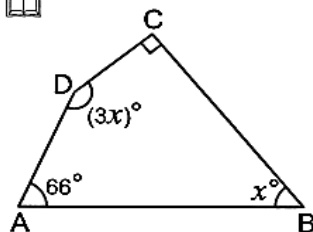
Ex.1) Answer the following :

1 Find the value of x in each of the following figures :

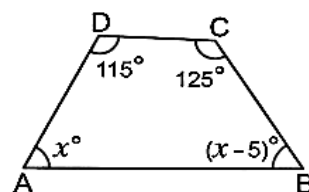
1



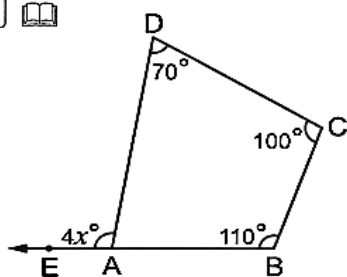
2



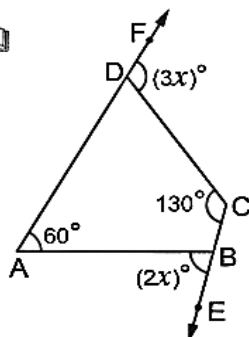
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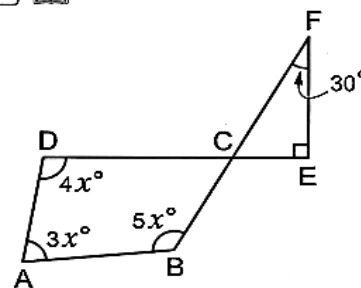
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5

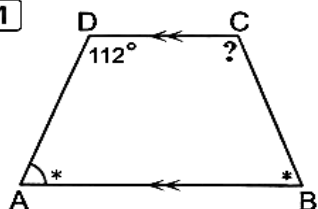


6



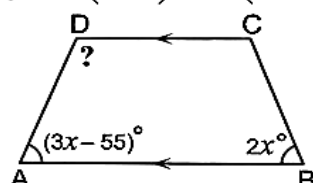
2 In each of the following shapes , if ABCD is a trapezium , find the measure of the angle indicated by the symbol (?) :

1

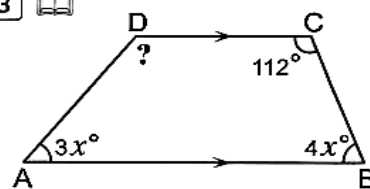


2

If $m(\angle A) = m(\angle B)$

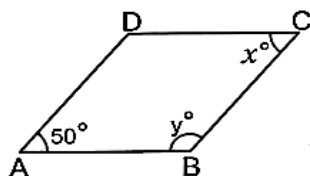


3

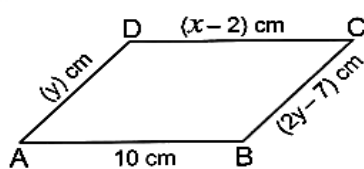


3 In each of the following shapes , if ABCD is parallelogram , find the value of :
x and y

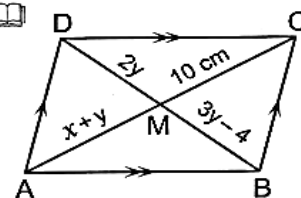
1



2



3



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4 In the opposite figure :

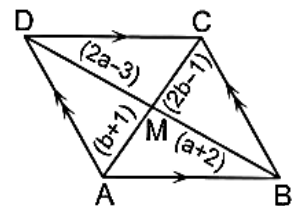
ABCD is a parallelogram. Find the length of each of :

1 $\overline{MB}$

2 $\overline{BD}$

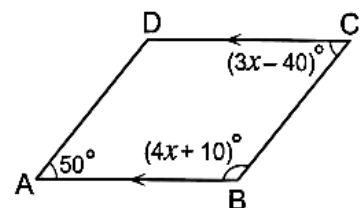
3 $\overline{MA}$

4 $\overline{MC}$



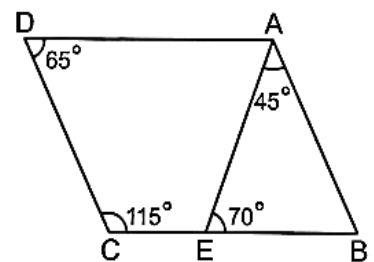
5 In the opposite figure :

Prove that : ABCD is a parallelogram.



6 In the opposite figure :

Prove that : ABCD is a parallelogram.

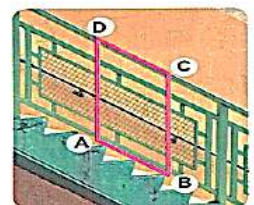


7 Architecture :

If ABCD is a parallelogram , $m(\angle B) = (3x + 37)^\circ$

, $m(\angle D) = (9x + 1)^\circ$

what is the measure of $\angle C$?

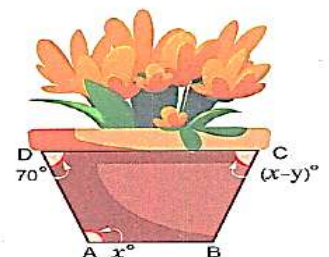


8 Agriculture :

A flowerpot that has one of its faces in the shape of a trapezium.

, $m(\angle C) = m(\angle D)$

Find : the value of y



Creative Thinking

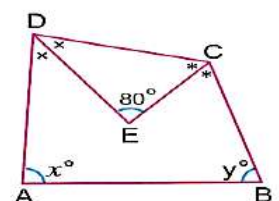
9 In the opposite figure :

$\overrightarrow{DE}$ bisects $\angle ADC$

, $\overrightarrow{CE}$ bisects $\angle BCD$

Find with proof : the value of $x + y$

In $\triangle DCB$:
 $\therefore m(\angle B) = 80^\circ$
 $\therefore m(\angle ECB) + m(\angle EDC) = 180^\circ - 80^\circ = 100^\circ$
 $\therefore m(\angle ECB) + m(\angle CDA) = 100^\circ \times 2 = 200^\circ$
 In the quadrilateral ABCD
 $\therefore m(\angle D) + m(\angle C) = 200^\circ$
 $\therefore m(\angle A) + m(\angle B) = 360^\circ - 200^\circ = 160^\circ$



SIMPLEST MATHS BOOKLETS

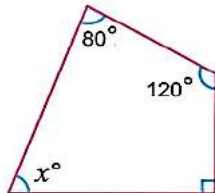
Quiz

Choose the correct answer from the given ones :

1 In the opposite figure :

What is the value of x ?

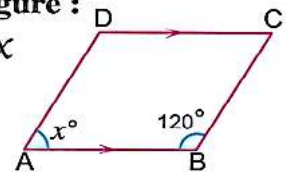
- (a) 70° (b) 80°
(c) 90° (d) 120°



2 In the opposite figure :

What is the value of x that makes ABCD a parallelogram ?

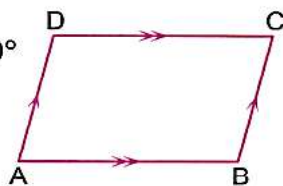
- (a) 109° (b) 120°
(c) 80° (d) 60°



3 In the opposite figure :

If $m(\angle A) + m(\angle C) = 140^\circ$, then what is the measure of $\angle B$?

- (a) 70° (b) 40°
(c) 110° (d) 220°

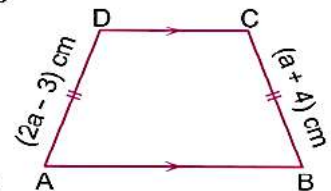


4 In the opposite figure :

ABCD is an isosceles trapezium.

What is the length of $\overline{AD}$ in centimeters ?

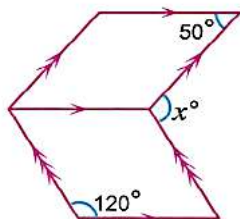
- (a) 4 (b) 6
(c) 7 (d) 11



5 In the opposite figure :

What is the value of x ?

- (a) 110° (b) 120°
(c) 130° (d) 140°

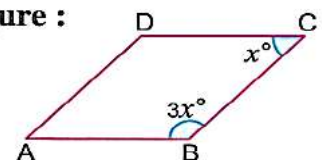


6 In the opposite figure :

ABCD is a parallelogram.

What is the measure of $\angle A$?

- (a) 30° (b) 45°
(c) 60° (d) 135°

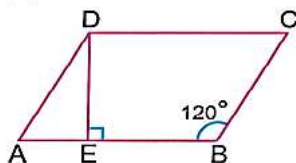


7 In the opposite figure :

ABCD is a parallelogram.

What is the measure of $\angle EDA$?

- (a) 30° (b) 60°
(c) 45° (d) 120°

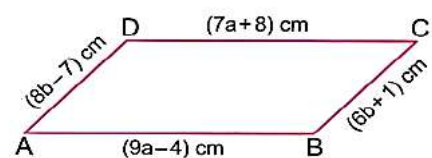


8 In the opposite figure :

ABCD is a parallelogram.

What is the value of $a + b$?

- (a) 4
(b) 7
(c) 9
(d) 10



SIMPLEST MATHS BOOKLETS

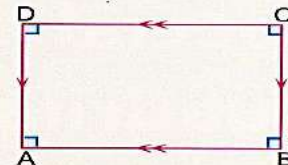
Lesson 6

Continue to Special Quadrilaterals

1 The Rectangle

The rectangle is a parallelogram that has one of its angles is a right angle

ABCD is a parallelogram ,
If $m(\angle A) = 90^\circ$
then ABCD is a rectangle.



Properties of the Rectangle

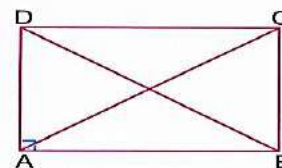
The rectangle is a parallelogram , so it has the same properties of the parallelogram , in addition to the following :

- 1 All its angles are equal in measure , the measure of each one is 90° .



$$m(\angle A) = m(\angle B) = m(\angle C) = m(\angle D) = 90^\circ$$

- 2 Its diagonals are equal in length.

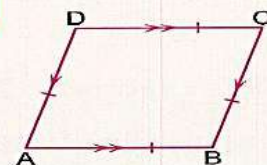


$$AC = BD$$

2 The Rhombus

The rhombus is a parallelogram in which two adjacent sides are equal in length

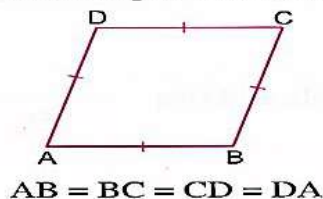
ABCD is a parallelogram ,
If $AB = BC$
then ABCD is a rhombus.



Properties of The Rhombus

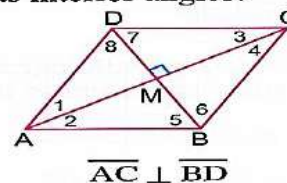
The rhombus is a parallelogram , so it has the same properties of the parallelogram , in addition to the following :

- 1 All its sides are equal in length.



$$AB = BC = CD = DA$$

- 2 The diagonals are perpendicular and bisect its interior angles.



$$\overline{AC} \perp \overline{BD}$$

$$m(\angle 1) = m(\angle 2) = m(\angle 3) = m(\angle 4) \\ , m(\angle 5) = m(\angle 6) = m(\angle 7) = m(\angle 8)$$

SIMPLEST MATHS BOOKLETS

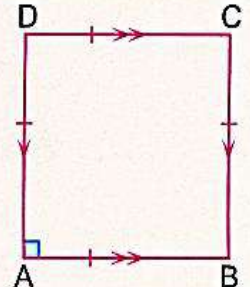
3 The Square

The square is a parallelogram that has one right angle and two adjacent sides are equal in length.

ABCD is a parallelogram ,

If $m(\angle A) = 90^\circ$, $AB = BC$

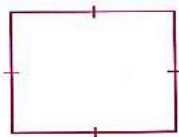
then ABCD is a square.



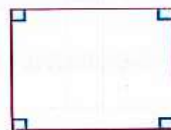
Properties of The Square

The square is a parallelogram with 4 right angles like a rectangle and 4 equal sides like a rhombus. Therefore , it has all the properties of the three shapes (parallelogram , rectangle and rhombus).

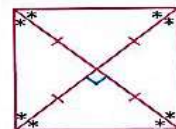
- 1 All its sides are equal in length.



- 2 All its angles are right angles.



- 3 Its diagonals are equal in length , perpendicular , and bisect its interior angles.



When does a parallelogram become a rectangle, rhombus, or square ?

A parallelogram becomes as :

A rectangle

If
It has one right angle ,
or
Its diagonals are equal in length.

A rhombus

If
It has two adjacent sides are equal in length ,
or
Its diagonals are perpendicular.

A square

If
It has one right angle and two adjacent sides are equal in length ,
or
It has one right angle and its diagonals are perpendicular ,
or
Its diagonals are equal in length and perpendicular ,
or
It has two adjacent sides are equal in length and the diagonals are equal in length.

Notes

- 1 The rectangle becomes a square if it has two adjacent sides are equal in length , or its diagonals are perpendicular.
- 2 The rhombus becomes a square if it has one right angle , or its diagonals are equal in length.

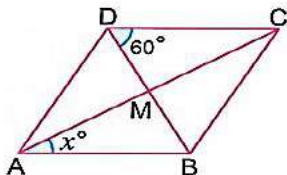
SIMPLEST MATHS BOOKLETS

Ex.1) Answer the following :

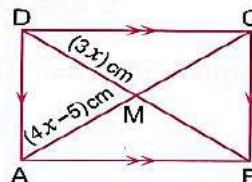
1

In each of the following figures , find the value of x :

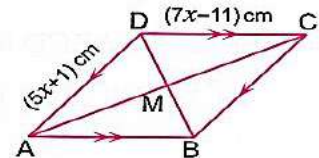
1 If ABCD is a rhombus



2 If ABCD is a rectangle



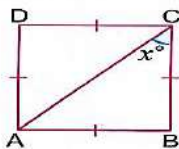
3 If ABCD is a rhombus



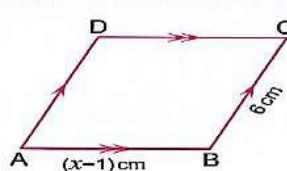
2

Find the value of x that makes the parallelogram ABCD in each of the following figures :

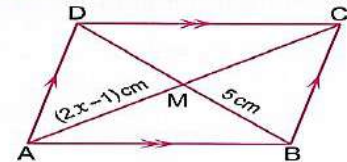
1 As a square



2 As a rhombus



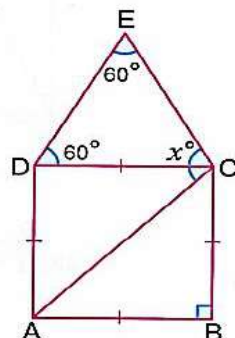
3 As a rectangle



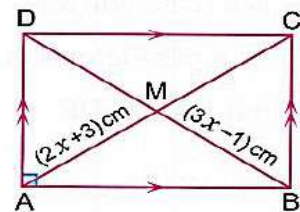
3

In each of the following figures , calculate with proof the value of x :

1



2



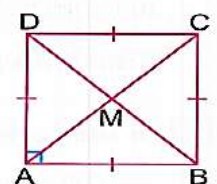
4

In the opposite figure :

ABCD is a square

$BD = 5a - 4$, $MC = 2a - 1$

Find the value of a , and then find the length of $\overline{AC}$



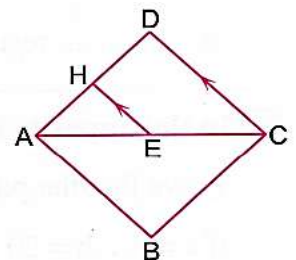
5

In the opposite figure :

ABCD is a rhombus , $E \in \overline{AC}$

, draw $\overline{EH}$ parallel to $\overline{DC}$ and intersect $\overline{AD}$ at H

Prove that : $m(\angle HEA) = m(\angle HAE)$



SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

1 The diagonals of a rectangle are

- (a) perpendicular.
- (b) equal in length.
- (c) equal in length and perpendicular.
- (d) bisect the interior angles.

2 The diagonals of a rhombus are

- (a) perpendicular and unequal in length.
- (b) equal in length and not perpendicular.
- (c) perpendicular and equal in length.
- (d) unequal in length and not perpendicular.

3 The diagonals of a square are

- (a) only perpendicular.
- (b) only equal in length.
- (c) perpendicular and equal in length.
- (d) neither equal in length nor perpendicular.

4 If two adjacent sides of a parallelogram are equal in length , then the shape becomes

- (a) a square.
- (b) a rhombus.
- (c) a rectangle.
- (d) a trapezium.

5 Which of the following sets of quadrilaterals have all their sides are equal in length ?

- (a) { Square , Rectangle }
- (b) { Trapezium , Rhombus }
- (c) { Square , Rhombus }
- (d) { Rectangle , Rhombus }

6 If ABCD is a parallelogram and $m(\angle A) = m(\angle B)$, then ABCD is

- (a) a rectangle.
- (b) a rhombus.
- (c) a square.
- (d) a trapezium.

7 If ABCD is a parallelogram in which $AC = BD$, $\overline{AC} \perp \overline{BD}$, then ABCD is

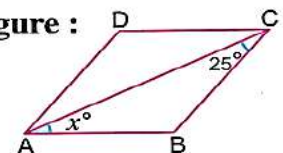
- (a) a trapezium. (b) a rhombus.
- (c) a rectangle. (d) a square.

8 In the opposite figure :

ABCD is a rhombus

What is the value of x ?

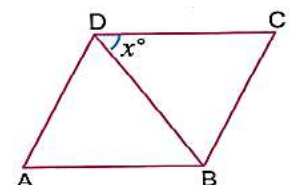
- (a) 25° (b) 50°
- (c) 100° (d) 130°



9 In the opposite figure :

If ABCD is a rhombus , which of the following expresses $m(\angle A)$?

- (a) x° (b) $2x^\circ$
- (c) $(180 - x)^\circ$ (d) $(180 - 2x)^\circ$



SIMPLEST MATHS BOOKLETS

Lesson 7

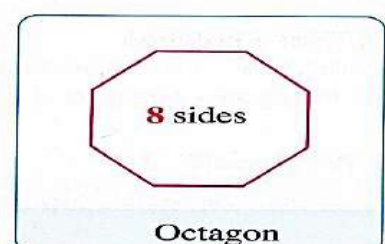
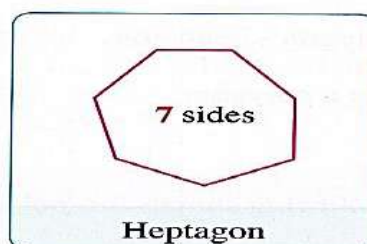
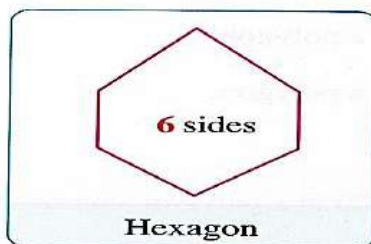
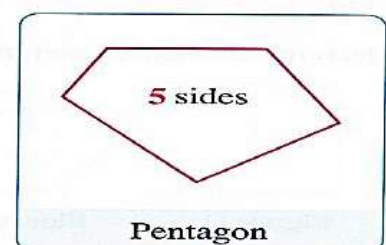
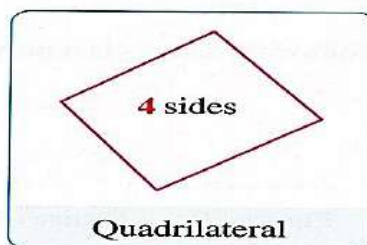
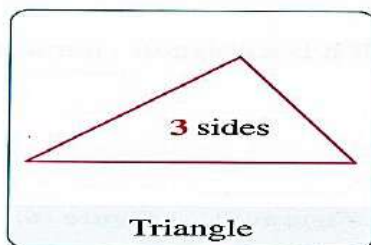
Polygons

Polygon

A polygon is a plane , closed shape formed from a union of three or more line segments , such that :

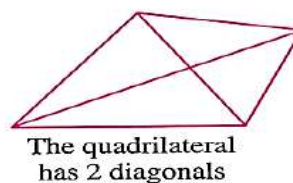
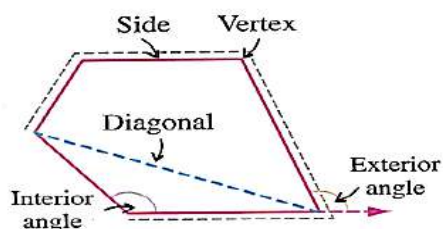
- 1 The line segments are known as the polygon's sides.
- 2 The line segments intersect at their endpoints , which are known as the polygons vertices.
- 3 No adjacent segments are on a straight line.

Examples of Some Polygons



Notes

- 1 Any line segment joining two non-consecutive vertices of the polygon is called "diagonal".
- 2 The included angle between two adjacent sides of a polygon is called an "interior angle".



- 3 The included angle between a side of the polygon and the extension of its adjacent side is called an "exterior angle".
- 4 The number of sides of any polygon = the number of its vertices = the number of its interior angles.

SIMPLEST MATHS BOOKLETS

Convex and Concave Polygons

Convex Polygon : A polygon is convex if the measure of any of its interior angles is less than 180° (it does not contain any reflex interior angles).



Concave Polygon : A polygon is concave if the measure of one of its interior angles at least is greater than 180° (it contains at least one reflex interior angle).

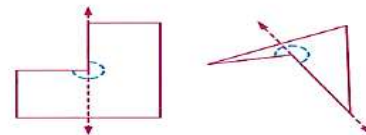


Notes

1 In a convex polygon : If a straight line is drawn to pass through any two consecutive vertices , then the remaining vertices lie on one side of this straight line.



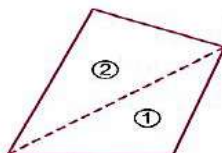
2 In a concave polygon : There are straight lines passing through two consecutive vertices and the remaining vertices lie on two different sides of the straight lines.



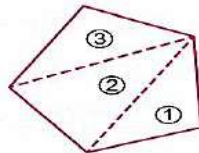
The Sum of the Measures of the Interior Angles of a Polygon

We know that : the sum of measures of the interior angles of the triangle equals 180° .

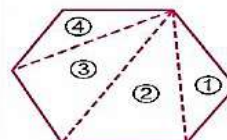
To find the sum of the measures of the interior angles of a convex polygon , draw all possible diagonals from one of its vertices , dividing the polygon into number of triangles as shown in the following figures :



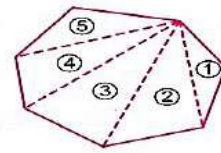
Quadrilateral



Pentagon



Hexagon



Heptagon

Polygon	Number of Sides	Number of Triangles	The sum of the measures of the Interior Angles
Quadrilateral	4	2	$2 \times 180^\circ = 360^\circ$
Pentagon	5	3	$3 \times 180^\circ = 540^\circ$
Hexagon	6	4	$4 \times 180^\circ = 720^\circ$
Heptagon	7	5	$5 \times 180^\circ = 900^\circ$
Octagon	8	6	$6 \times 180^\circ = 1,080^\circ$
Nonagon	9	7	$7 \times 180^\circ = 1,260^\circ$
Decagon	10	8	$8 \times 180^\circ = 1,440^\circ$

From the table , you can deduce that : Number of triangles = Number of sides minus 2

SIMPLEST MATHS BOOKLETS

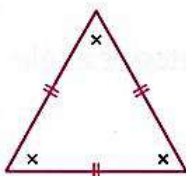
Regular Polygon

A regular polygon is a polygon that has both of the following properties :

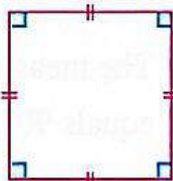
- 1 All its sides are equal in length.
- 2 All its interior angles are equal in measure.

Examples of Regular Polygons

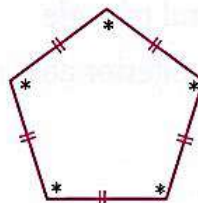
Regular triangle
(Equilateral Triangle)



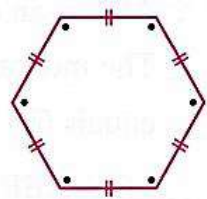
Regular quadrilateral
(Square)



Regular pentagon



Regular hexagon



Thus , the measure of each interior angle of a regular polygon equals

$$= \frac{\text{The sum of the measures of the interior angles}}{\text{Number of interior angles}}$$

For example :

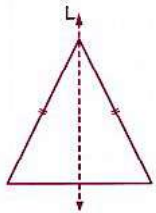
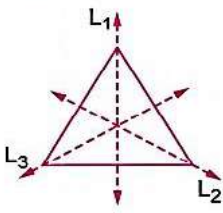
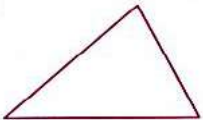
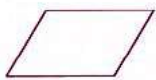
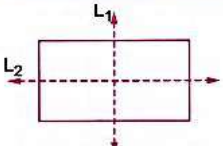
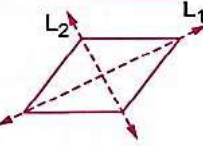
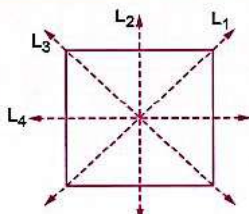
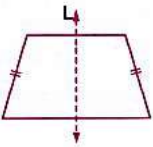
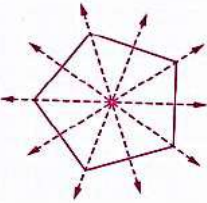
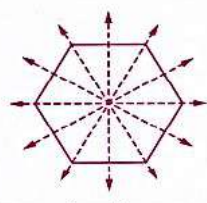
The regular polygon	Number of interior angles	The measure of each interior angle
Equilateral triangle	3	$180^\circ \div 3 = 60^\circ$
Square	4	$360^\circ \div 4 = 90^\circ$
Regular pentagon	5	$540^\circ \div 5 = 108^\circ$
Regular hexagon	6	$720^\circ \div 6 = 120^\circ$
Regular octagon	8	$1,080^\circ \div 8 = 135^\circ$
Regular decagon	10	$1,440^\circ \div 10 = 144^\circ$

SIMPLEST MATHS BOOKLETS

Axes of Symmetry in Polygons

The axis of symmetry of a shape is a straight line that divides the shape into two identical parts. When the shape is folded along the axis of symmetry, the both parts are coincide. A shape may have one or more axes of symmetry, or no axes of symmetry.

Examples of Some Polygons

Shape			
Number of axes of symmetry	1	3	(None)
Shape			
Number of axes of symmetry	(None)	2	2
Shape			
Number of axes of symmetry	4	(None)	1
Shape			
Number of axes of symmetry	5	6	

Note : The number of axes of symmetry in a regular polygon is equal to the number of its sides.

SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 The number of diagonals in a quadrilateral is
- 2 The number of diagonals in a pentagon is
- 3 The number of diagonals in a trapezium is
- 4 When all possible diagonals are drawn from one vertex of a convex octagon , the number of the formed triangles equals
- 5 If all possible diagonals are drawn from one vertex of a convex polygon is 4 diagonals , then the number of the formed triangles is
- 6 The sum of the measures of the interior angles of a hexagon equals
- 7 The sum of the measures of the interior angles of a heptagon equals
- 8 If the number of triangles formed by drawing all the possible diagonals from one vertex of a convex polygon is 7 , then the sum of the measures of the interior angles of the polygon equals
- 9 The measure of each interior angle of a regular octagon equals
- 10 The measure of each interior angle of a regular decagon equals
- 11 The number of axes of symmetry of a square is
- 12 The number of axes of symmetry of a parallelogram is
- 13 The number of axes of symmetry of a regular hexagon is
- 14 The number of axes of symmetry of an isosceles trapezium is

SIMPLEST MATHS BOOKLETS

Ex.1) Answer the following :

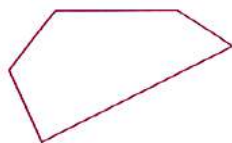
1

Which of the following polygons are convex and which are concave ?

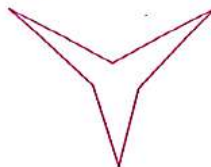
1



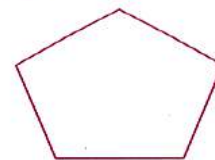
2



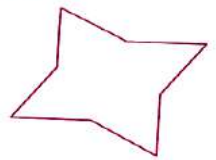
3



4



5



2

ABCD is a quadrilateral in which :

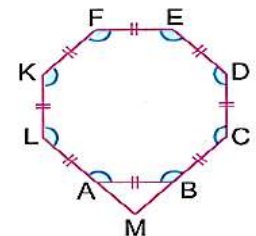
$m(\angle A) = 4x^\circ$, $m(\angle B) = 5x^\circ$, $m(\angle C) = 7x^\circ$ and $m(\angle D) = 20x^\circ$

Find the value of x , then determine whether the quadrilateral is convex or concave.

3

In the opposite figure :

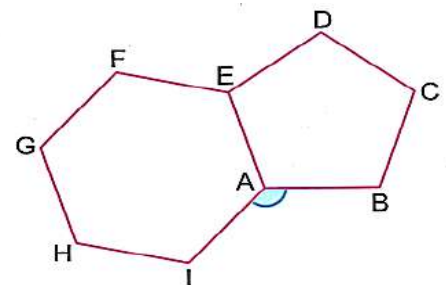
Find : $m(\angle AMB)$



4

The opposite figure consists of a regular pentagon and a regular hexagon.

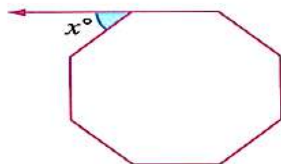
Calculate : $m(\angle IAB)$



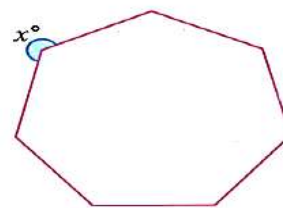
5

Each of the following is a regular polygon , find the value of x and determine the number of axes of symmetry for each polygon :

1



2

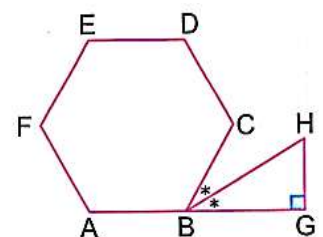


6

In the opposite figure :

ABCDEF is a regular hexagon.

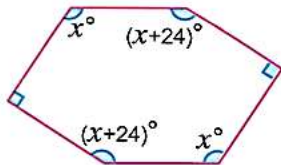
Find with proof : $m(\angle H)$



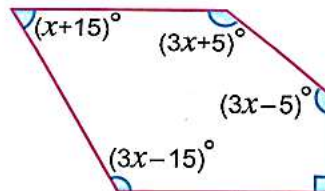
SIMPLEST MATHS BOOKLETS

7 Find the value of x in each of the following polygons :

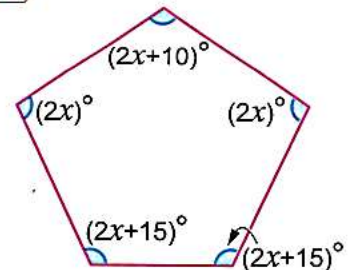
1



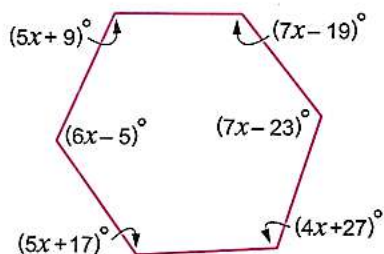
2



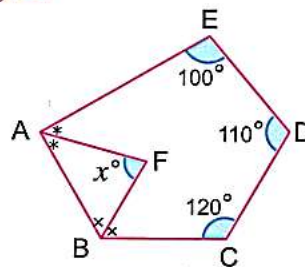
3



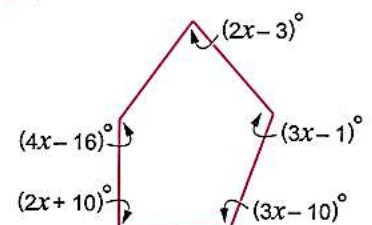
4



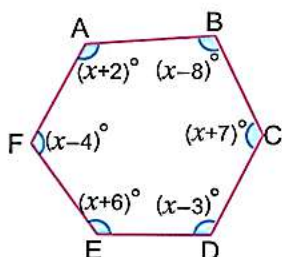
5



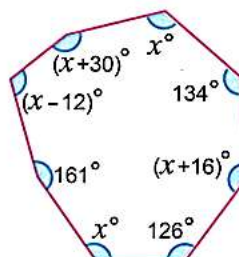
6



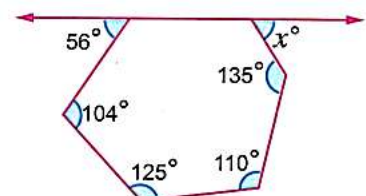
7



8



9

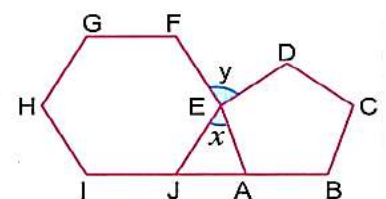


8

In the opposite figure :

ABCDE is a regular pentagon
 , and EFGHIJ is a regular hexagon
 , $J \in \overline{IB}$, $A \in \overline{IB}$

Find the value of each of : x and y

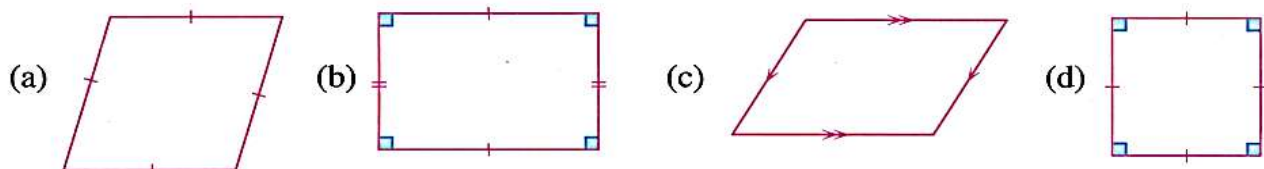


SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

1 Which of the following figures does not have an axes of symmetry ?



2 Which of the following angles must be one of the interior angles of a polygon to be concave ?

- (a) Straight (b) Acute
(c) Right (d) Reflex

3 How many axes of symmetry does a regular polygon with 9 sides have ?

- (a) 9 (b) 7
(c) 18 (d) 11

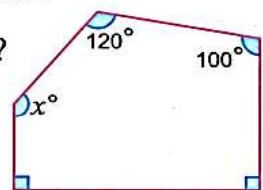
4 What is the measure of the interior angle of a regular polygon with 10 sides ?

- (a) 108° (b) 120°
(c) 135° (d) 144°

5 In the opposite figure :

What is the value of x ?

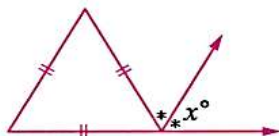
- (a) 120° (b) 140°
(c) 150° (d) 135°



6 In the opposite figure :

What is the value of x ?

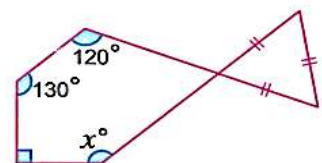
- (a) 30°
(b) 60°
(c) 120°
(d) 180°



7 In the opposite figure :

What is the value of x ?

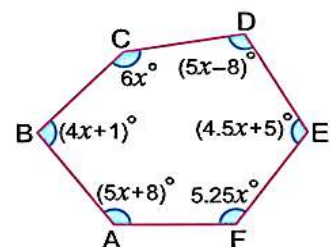
- (a) 110°
(b) 120°
(c) 130°
(d) 140°



8 In the opposite figure :

What is the value of x ?

- (a) 12° (b) 24°
(c) 18° (d) 36°



SIMPLEST MATHS BOOKLETS

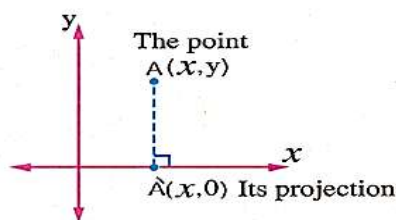
Lesson 8

Coordinates

Projection of a Point on the coordinate Axes

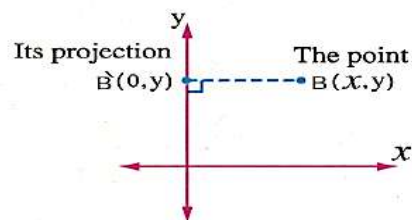
The projection of a point on an axis is the location where a perpendicular line from that point meets the axis.

The projection of a point on the x -axis



• Point (x, y) $\xrightarrow{\text{The projection of the point on the } x\text{-axis}}$ $(x, 0)$

The projection of a point on the y -axis



• Point (x, y) $\xrightarrow{\text{The projection of the point on the } y\text{-axis}}$ $(0, y)$

Notice that

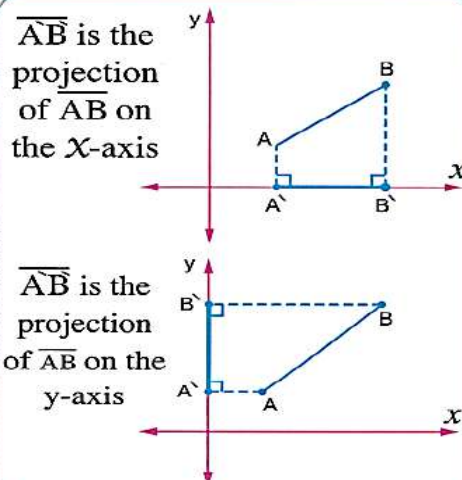
If a point lies on one of the two axes, its projection on that axis is the point itself, and its projection on the other axis is the origin.

For example :

- The point $A(3, 0)$ lies on the x -axis, its projection on the x -axis is itself, i.e. $A(3, 0)$ and its projection on the y -axis is $O(0, 0)$
- The point $B(0, -8)$ lies on the y -axis, its projection on the y -axis is itself, i.e. $B(0, -8)$ and its projection on the x -axis is $O(0, 0)$

The projection of a line segment on the coordinate axes

The projection of a line segment on one of the axes, whether the x -axis or the y -axis, is the projection of each point of the line segment on that axis.



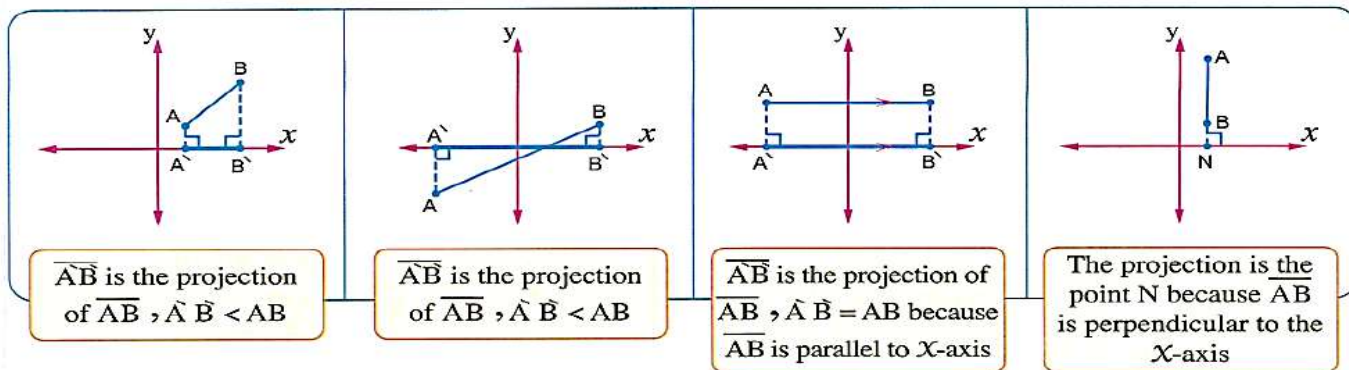
From this:

The projection of a line segment on one axis is the line segment whose endpoints are the projections of the original segment's endpoints on that axis.

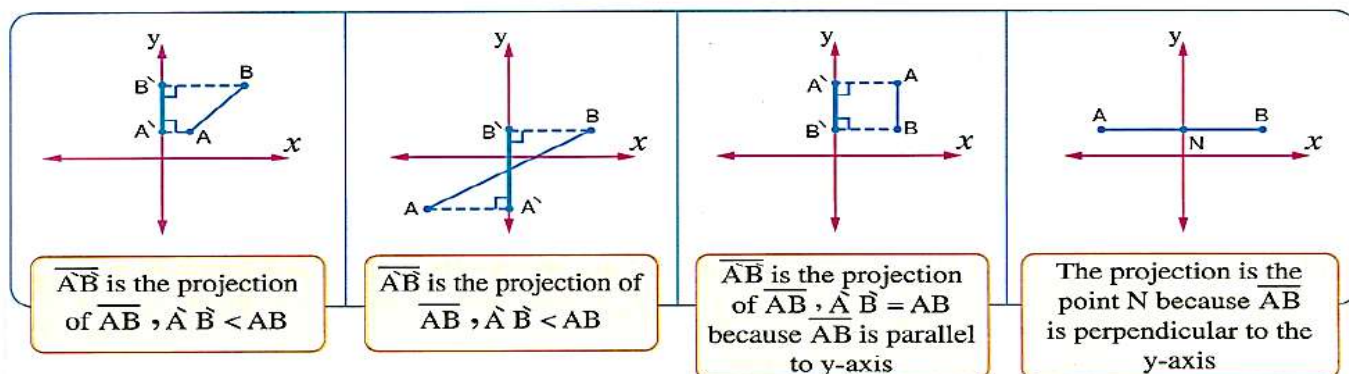
i.e., if A' is the projection of A , and B' is the projection of B on the axis, then $A'B'$ is the projection of AB on that axis.

SIMPLEST MATHS BOOKLETS

• In each of the following cases , notice the projection of $\overline{AB}$ on the X-axis :



• In each of the following cases , notice the projection of $\overline{AB}$ on the y-axis :



From the above , note that :

- 1 The length of the projection of a line segment on one of the two axes is less than or equal to the length of the line segment itself.
- 2 If the line segment is parallel to the axis , then the length of its projection on that axis equals its length.
- 3 If the line segment is perpendicular to the axis , its projection on that axis is a point.

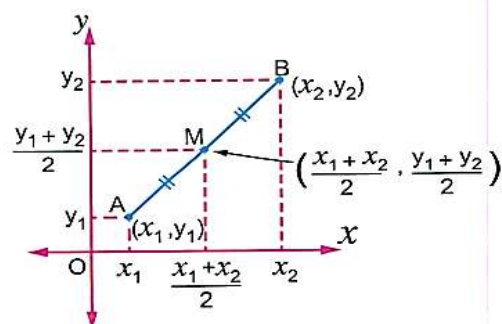
The Coordinates of the Midpoint of a Line Segment

The midpoint of a line segment is the point that lies on the line segment and is equidistant from its endpoints.

If M is the midpoint of a line segment,

Where A (x_1 , y_1) , B (x_2 , y_2)

then , $M = \left(\frac{x_1 + x_2}{2} , \frac{y_1 + y_2}{2} \right)$



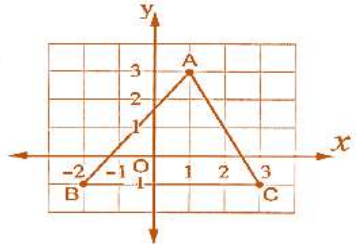
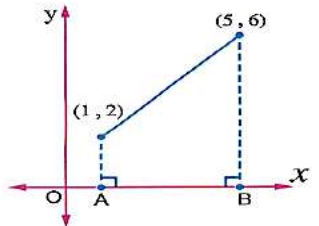
SIMPLEST MATHS BOOKLETS

Ex.1) Complete the following:

- 1 The point $(-3, 5)$ lies in the quadrant.
- 2 The point $(7, 0)$ lies on the -axis.
- 3 The point $(0, -8)$ lies on the -axis.
- 4 If $a > 0$, then the point $(-2a, a + 1)$ lies in the quadrant.
- 5 The point with coordinates $(|-5|, (-2)^2)$ lies in the quadrant.
- 6 If the point (a, b) lies in the second quadrant, then the point $(2a, -b)$ lies in the quadrant.
- 7 If $(4 - 2k, 3k + 9)$ lies on the X -axis, then k equals
- 8 If $A(3k - 6, 4k)$ lies on the y -axis, then the coordinates of A (.....,).
- 9 If the point $(4k + 2, 5)$ lies on the y -axis, then the point $(k + 5, 2k)$ lies in the quadrant.
- 10 The projection of the point $(-2, 4)$ on the X -axis is
- 11 The projection of the point $(4, -3)$ on the y -axis is
- 12 The projection of the point $(0, -7)$ on the X -axis is
- 13 The projection of the point $(2.5, 0)$ on the -axis is itself.
- 14 The projection of the point $(0, 10)$ on the -axis is the origin.
- 15 A point whose projection on the X -axis is $(3, 0)$ and its projection on the y -axis is $(0, -2)$ so the point is
- 16 The projection of the point $(a + 3, a - 2)$ on the X -axis is itself, then the point is
- 17 If $\overline{A\hat{B}}$ is the projection of $\overline{AB}$ on the X -axis, where $A(5, 1)$, $B(2, 7)$, then the coordinates of $\hat{A}$ (.....,) and $\hat{B}$ (.....,)
- 18 The length of the projection of a line segment on the X -axis is the length of the line segment itself.

SIMPLEST MATHS BOOKLETS

Ex.1) Answer the following :

- 1 In each of the following, plot the points on the coordinate plane:
 - ① $A(3, 2)$, $B(-1, 2)$, $C(-3, 0)$, $D(1, 0)$, then calculate the area of the figure ABCD
 - ② $A(1, 1)$, $B(4, 1)$, $C(4, 4)$, $D(1, 4)$, what is the type of the shape? Find its area.
- 2  From the opposite graph :
Determine the coordinates of the vertices of the triangle ABC, then calculate its area.
 
- 3  If the point $(a - 2, 3a + 9)$ lies on the X -axis, determine the quadrant in which the point $(a, 6 - a)$ is located.
- 4  If the point $A(4k + 4, -k + 3)$ lies on the y -axis, determine the quadrant in which the point $B(-2k, 4k + 1)$ is located.
- 5  If the point $A(-3k, 2k - 4)$ lies on the X -axis, determine the quadrant in which the point $B(k - 6, -3k)$ is located.
- 6  In the opposite figure :
What is the distance between the points A and B ?
 
- 7  Determine the length of the projection of line segment $\overline{AB}$ on the X -axis in each of the following cases :

① $A(-2, 1)$, $B(3, 6)$	② $A(-4, 3)$, $B(-2, 3)$
③ $A(5, 5)$, $B(5, -1)$	④ $A(-3, 4)$, $B(2, 2)$
- 8  In the coordinate plane, draw $\overline{AB}$, where the coordinates of points A and B are $A(5, 6)$ and $B(3, 2)$ and determine the following on the plane :
 - ① The projection of $\overline{AB}$ on the X -axis.
 - ② The projection of $\overline{AB}$ on the y -axis, then calculate the length of each projection.

SIMPLEST MATHS BOOKLETS

- 9** Determine the coordinates of the midpoint of $\overline{AB}$ where :
- | | |
|----------------------------|----------------------------|
| 1 A (2 , -2) , B (-6 , 8) | 2 A (1 , -6) , B (5 , 2) |
| 3 A (5 , 2) , B (-1 , 6) | 4 A (-3 , 5) , B (3 , -5) |
- 10** If M is the midpoint of $\overline{AB}$, find x and y in each of the following cases :
- | | |
|--|---|
| 1 M (x , 0) , A (1 , -5) , B (2 , y) | 2 M (5 , 3) , A (15 , y) , B (x , -2) |
| 3 M (6 , -4) , A (5 , -3) , B (x , y) | 4 M (0 , -3) , A (x , -10) , B (7 , y) |
- 11** If ABCD is a parallelogram where A (-1 , 1) , B (4 , 2) and D (1 , 4)
Determine the coordinates of the following :
- | | |
|--|-----------------|
| 1 The point of intersection of its diagonals. | 2 The vertex C |
|--|-----------------|
- 12** If ABCD is a parallelogram where A (-4 , 2) , B (4 , -2) and C (9 , 1)
Determine the coordinates of the following :
- | | |
|--|-----------------|
| 1 The point of intersection of its diagonals. | 2 The vertex D |
|--|-----------------|
- 13** If ABCD is a rhombus where A (3 , 5) , B (12 , -3) and C (13 , 9)
Determine the coordinates of the following :
- | | |
|---|-----------------|
| 1 The point intersection of its diagonals. | 2 The vertex D |
|---|-----------------|
- 14** If A (3 , -1) and B (-1 , -1) , draw the square ABCD such that point C is located in the second quadrant.

SIMPLEST MATHS BOOKLETS

Quiz

Choose the correct answer from the given ones :

- | | |
|--|--|
| <p>1 In which quadrant is the point $(3, -4)$ located ?</p> <p>(a) 1st quadrant (b) 2nd quadrant
(c) 3rd quadrant (d) 4th quadrant</p> | <p>2 Which of the following points lies in the third quadrant ?</p> <p>(a) $(-5, 3)$ (b) $(3, 4)$
(c) $(-2, -1)$ (d) $(8, -6)$</p> |
| <p>3 Which of the following points does not lie on the y-axis ?</p> <p>(a) $(0, -5)$ (b) $(3, 0)$
(c) $(0, 0)$ (d) $(0, 2)$</p> | <p>4 If the point $(3, k - 2)$ lies on the x-axis, what is the value of k ?</p> <p>(a) -3 (b) -2
(c) 2 (d) 3</p> |
| <p>5 If $x < 0$ and $y > 0$, in which quadrant is the point $(x, -y)$ located ?</p> <p>(a) 1st quadrant (b) 2nd quadrant
(c) 3rd quadrant (d) 4th quadrant</p> | <p>6 What is the projection of the point $(-3, 5)$ on the y-axis?</p> <p>(a) $(0, 5)$ (b) $(-3, 0)$
(c) $(3, -5)$ (d) $(-3, 5)$</p> |
| <p>7 What is the point representing the projection of the point $(-3, 5)$ on the x-axis ?</p> <p>(a) $(0, 5)$ (b) $(-3, 0)$
(c) $(3, -5)$ (d) $(-3, 5)$</p> | <p>8 If the point (a, b) lies in the 3rd quadrant, then the quadrant which the point $(-2a, b - 6)$ lies in is</p> <p>(a) 1st quadrant (b) 2nd quadrant
(c) 3rd quadrant (d) 4th quadrant</p> |
| <p>9 If the origin is the midpoint of $\overline{AB}$ where A $(5, -2)$, then B is</p> <p>(a) $(2, 5)$ (b) $(5, -2)$
(c) $(-2, -5)$ (d) $(-5, 2)$</p> | <p>10 If the origin is the midpoint of $\overline{AB}$ and A is located in the 2nd quadrant, in which quadrant is point B located ?</p> <p>(a) 1st quadrant (b) 2nd quadrant
(c) 3rd quadrant (d) 4th quadrant</p> |
| <p>11 If C $(-3, y)$ is the midpoint of $\overline{AB}$ where A $(x, -6)$ and B $(1, -8)$, then the value of $x + y$ is</p> <p>(a) -11 (b) 11
(c) -18 (d) -14</p> | <p>12 If the x-axis bisects $\overline{AB}$ where A $(3, 2)$, B $(-2, y)$, then the value of y is</p> <p>(a) 3 (b) 2
(c) -2 (d) 4</p> |